

REDACTED



{In Archive} RE: CONTAMINATION OF WELL WATER

Jackson, David A (EEC) to: Robert Olive, Baker, William (EEC)

10/12/2011 09:36 AM

Cc: "Barclay, Sally (EEC)", Fred McManus

Archive:

This message is being viewed in an archive.

That is our usual procedure, but I will defer to Bill Baker, Supervisor of the Bowling Green Regional Office.

David A. Jackson, P.G
Geologist Supervisor Registered
Groundwater Section
Watershed Management Branch
Kentucky Division of Water

Exemption 6 Personal Privacy

(502) 564-3410 ext 4932
Fax (502) 564- 9899

-----Original Message-----

From: Olive.Robert@epamail.epa.gov [
mailto:Olive.Robert@epamail.epa.gov]
Sent: Wednesday, October 12, 2011 8:59 AM
To: Jackson, David A (EEC); Baker, William (EEC)
Cc: Barclay, Sally (EEC); mcmanus.fred@epa.gov;
Olive.Robert@epamail.epa.gov
Subject: RE: CONTAMINATION OF WELL WATER

David, Sally, Bill:

Thank you for forwarding to me the complaint from
of
Bowling Green, KY. Sounds like this could be a UIC
issue.

There are several ways we could handle this. If an
inspector from the
Bowling Green office is planning on looking at the
situation, that would
be great. If they confirm that this is a UIC issue,
EPA will be glad to
step in and work with Bill's staff to address the
situation. Does this
sound appropriate?

Thanks.

Robert Olive

olive.robert@epa.gov 404 562-9423
U.S. EPA, Region 4
Ground Water and SDWA Enforcement Section
Safe Drinking Water Branch
61 Forsyth Street, Atlanta, GA 30303-8960

From: "Jackson, David A (EEC)"
<DavidA.Jackson@ky.gov>
To: "Leon" <fergusons1947@bellsouth.net>
Cc: "Barclay, Sally (EEC)"
<Sally.Barclay@ky.gov>, "Nicotera,
Thomas (EEC)" <Thomas.Nicotera@ky.gov>,
Robert
Olive/R4/USEPA/US@EPA, "Baker, William
(EEC)"
<William.Baker@ky.gov>
Date: 10/11/2011 03:12 PM
Subject: RE: CONTAMINATION OF WELL WATER

Exemption 6 Personal Privacy

Dear

I am forwarding your e-mail to Ms. Sally Barclay our complaints coordinator, so that she can log this information in as an official complaint. Ms Barclay will likely call you if she needs additional information. Once the complaint has been logged in, someone from our office will be assigned to investigate the situation.

In addition I am copying Robert Olive at USEPA Region 4. Mr. Olive's office permits underground injection control, or UIC activities that occur in KY, which the draining of stormwater into the subsurface via Class V wells would fall under.

If you could send us the physical address of the location of your well, we could begin the investigation while the incident is being logged in.

Thank you, and if you have additional questions, please feel free to contact me anytime.

Sincerely
DAJ

David A. Jackson, P.G
Geologist Supervisor Registered
Groundwater Section
Watershed Manangement Branch
Kentucky Division of Water

(502) 564-3410 ext 4932
Fax (502) 564- 9899

From:
Sent: Monday, October 10, 2011 12:52 PM
To: Jackson, David A (EEC)
Subject: CONTAMINATION OF WELL WATER

Hi, I am a concerned citizen that has a water well and I am really concerned about a potential problem that is happening in our neighborhood. I live at _____ ky. and a farmer 2 miles north of us is in the process of establishing a drainage system that will contaminate the water supply for miles around. _____ has drilled several water wells and is running drainage pipes from a manhole inside a 500 acre farm that will drain flood water that stands in approx. 200 acres of this field into the wells. Water stands in the field approx 4 months out of the year and it accumulates after heavy rains when the cave system fills up so the water has no place to go. This property is located on Three Springs road in Warren Co. Please respond to my concern if this is the proper place to help stop this process. Thanks

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{In Archive} Re: Failing Septic Tank - PoJo's Truck Stop Register, GA

Bijan Rahbar to: Robert Olive

12/18/2009 10:29 AM

History: This message has been replied to.

Archive: This message is being viewed in an archive.

Robert,
I guess you have talked to Brad too. He said he has talked to you and he has given the owner 30 days to address the problem.
Thanks, Bijan

>>> <Olive.Robert@epamail.epa.gov> 12/16/2009 10:44 am >>>

Bijan:

called to report a failing septic system at PoJo's Truck Stop in Register, GA. The truck stop is located at Exit 116 off Interstate 16 at the intersection with Hwy 301/25 N. This is SW of Statesboro, GA.

Under previous owners, the truck stop used a pump station to pump sewage to an adjacent property where functioning field lines were located. Under new owners, a new set of field lines was installed at the truck stop property. These field lines have been failing to the surface and impacting property.

Mr. Brad Wiggins (912-764-3800) is with the Bulloch County Health Department. I have not been able to get in contact with him yet.

A quick solution may be for the Truck Stop to reconnect to the old set of field lines.

Robert Olive

olive.robert@epa.gov 404 562-9423
U.S. EPA, Region 4
Ground Water and SDWA Enforcement Section
Safe Drinking Water Branch
61 Forsyth Street, Atlanta, GA 30303-8960

Large Capacity
Septic System
GA



**Septic System & Field Lines letter-95555 Crossville,Highway - Sparta
Tennessee**

Larry Cole to: Scotty Sorrells
Cc: Fred McManus, Becky Allenbach

09/13/2012 12:43 PM

From: Larry Cole/R4/USEPA/US
To: Scotty Sorrells <Scotty.Sorrells@tn.gov>
Cc: Fred McManus/R4/USEPA/US@EPA, Becky Allenbach/R4/USEPA/US@EPA

Scotty, the letter EPA received is attached dated September 3, 2012.

The letter is to the point and identifies the issue & possible address and has no contact information except being written by a neighbor in the Sparta, Tennessee area.

Attached also after the letter, is a picture I pulled down for Google Maps of the area which could be the newly constructed building that was referenced, but the 9555 Crossville Highway address mentioned in the letter is different from the 9571 Crossville Highway address which is mentioned in the Google Map picture I attached. This is the only new construction I saw near this address in the area, but I'm not sure how old this google-map is.

Please let me know if you find out anything, since this complaint could have also been reported to a TDEC field office or the TN Department of Health.

Thanks,

Larry Cole
GW & SDWA Enforcement Section
404-562-9474



PossibleLocation9555CrossvilleTN.PDF

August 30, 2012

E.P.A.

Enforcement

REDACTED

Exemption 6 Personal Privacy

We wrote to the E.P.A. previously regarding this issue and to date there have not been any changes made at this location. Please give this letter to someone who can and will do something about this.

old store building located at 9555 Crossville Highway in Sparta Tennessee. then tore down the building and dug out the in ground fuel tanks. then proceeded to put in new tanks and build a new building. The problem is that put in a septic tank in ground that does not perk and did not put in field line. An eye witness reports that has ran the septic tank to a nearby small stream.

When the old store was here water mixed with sewage sat on top of the ground. Since dug out the dirt and replaced it with large rocks we know the problem will persist once he opens his new store which states will be within the next 6 weeks.

Mr. Bumbalough will do nothing about this since he was the one who gave the permits for land that does not perk and has never perked.

There have been no changes to the septic system or field line. Would you please send someone out that can and will do an actual perk test on this land and make sure that we don't have to put up with sewage waste again. Please.

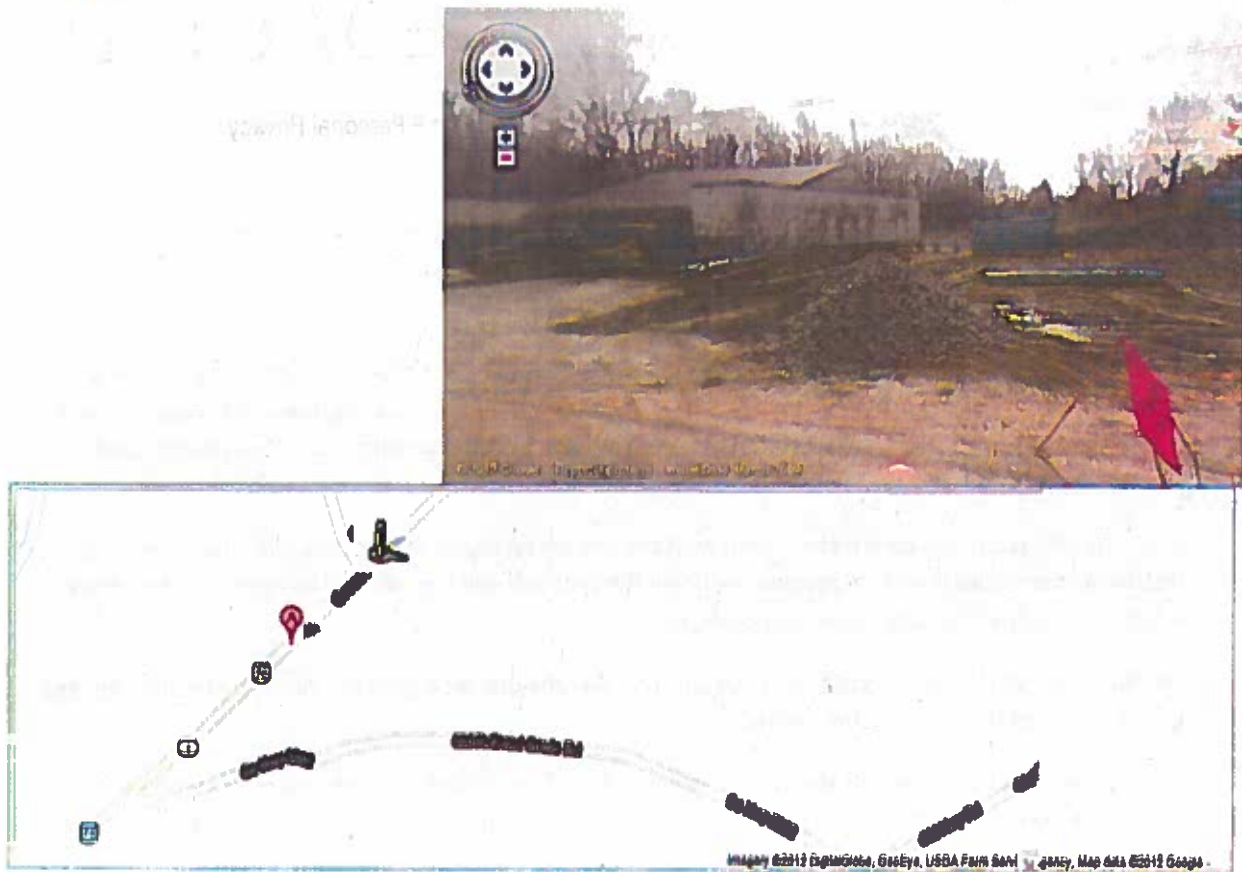
Sincerely,

A neighbor

RECEIVED
SEP - 3 2012
OCE



To see all the details that are visible on the screen, use the "Print" link next to the map.





Address 9571 U.S. 70

Address is approximate





**Fw: Seeking UIC Program Assistance for Oil Seep in Amandaville ,
Cumberland County , KY**

Fred McManus to: marvin.combs

03/26/2012 10:45 AM

FYI!

----- Forwarded by Fred McManus/R4/USEPA/US on 03/26/2012 10:44 AM -----

From: Carol Chen/R4/USEPA/US
To: Art Smith/R4/USEPA/US@EPA
Cc: Carol Chen/R4/USEPA/US@EPA, Fred McManus/R4/USEPA/US@EPA, Bill Mann/R4/USEPA/US@EPA
Date: 03/26/2012 07:28 AM
Subject: Re: Fw: Seeking UIC Program Assistance for Oil Seep in Amandaville , Cumberland County, KY

Art, thanks for notifying me. I was not in Friday when you called. We definitely need to be there. I'll call the contractor and discuss and get back with you.

Carol 404-562-9415

Art Smith

Carol, I left you a voice mail message a short wh...

03/23/2012 02:05:46 PM

From: Art Smith/R4/USEPA/US
To: Carol Chen/R4/USEPA/US@EPA
Cc: Bill Mann/R4/USEPA/US@EPA
Date: 03/23/2012 02:05 PM
Subject: Fw: Seeking UIC Program Assistance for Oil Seep in Amandaville , Cumberland County, KY

Carol, I left you a voice mail message a short while ago. As you can see from the forwarded email message below, I have traded emails with Bill Mann on this case.

I am planning to go out to the spill site on April 2, and will be providing direction to the operator to increase the injection pressure to see if the oil spill volume increases. If there is a documented effect due to increased pressure, the operator will have to cease injection of fluids into the well. Because the well is permitted by EPA, I was hoping that you could send your contractor to observe so that the UIC program is in the loop.

Thanks.

----- Forwarded by Art Smith/R4/USEPA/US on 03/23/2012 01:53 PM -----

From: Bill Mann/R4/USEPA/US
To: Art Smith/R4/USEPA/US@EPA
Date: 03/21/2012 01:30 PM
Subject: Re: Seeking UIC Program Assistance for Oil Seep in Amandaville , Cumberland County, KY

Art,

I'll dig up the monitoring reports and get them to you. Attached is a copy of the UIC Permit, The Statement of Basis for the permit and other letters/forms that our section wrote. The permitted injection zone is pretty deep. If I can be of further assistance let me know.

Bill Mann
404-562-9452

[attachment "10 Public notice.doc" deleted by Art Smith/R4/USEPA/US] [attachment "12 Statement of basis.doc" deleted by Art Smith/R4/USEPA/US] [attachment "UIC 15 Cover Page.doc" deleted by Art Smith/R4/USEPA/US] [attachment "UIC 15 Part I.doc" deleted by Art Smith/R4/USEPA/US] [attachment "Part II 3-2007.doc" deleted by Art Smith/R4/USEPA/US] [attachment "11.doc" deleted by Art Smith/R4/USEPA/US] [attachment "17-1 improved.doc" deleted by Art Smith/R4/USEPA/US]

Art Smith

I got your name off of the internet as a Class II U...

03/21/2012 01:16:08 PM

From: Art Smith/R4/USEPA/US
To: Bill Mann/R4/USEPA/US@EPA
Cc: "Tooley, Johnny (EEC)" <Johnny.Tooley@ky.gov>, john.rogers@ky.gov, Greg Powell/C1/USEPA/US@EPA
Date: 03/21/2012 01:16 PM
Subject: Seeking UIC Program Assistance for Oil Seep in Amandaville, Cumberland County, KY

I got your name off of the internet as a Class II UIC contact. If there is someone assigned to Kentucky who I should be in touch with, please let me know.

I'm a Region 4 OSC stationed in Louisville, KY. In June 2011, I was asked by KDEP to check out a continuous oil discharge into Crocus Creek which is a tributary of the Cumberland River. There is active oil production on the adjacent farm. See attached sketch for reference.

The active lease has a permitted injection well (UIC Permit #KY10891). I am interested in the most recent Annual Monitoring Report to determine if an increase in injection volumes during the summer months may be an influence on the oil spill. We ran samples on the oil discharging to the creek and from a well producing at the same interval where injection is occurring and they are a match.

Also, it appears as if this well was converted from a production well to an injection well at some point in the past. If there records on when that occurred, please forward that information as well.

Thanks.

Art Smith, US EPA On-Scene Coordinator
Rm. 172A
Romano L. Mazzoli Federal Building
600 Dr. Martin Luther King Jr. Place
Louisville, KY 40202

voice: (502) 582-5161
fax: (502) 582-5268

[attachment "Figure - Oil Wells Quarter Mile_03.15.12.pdf" deleted by Bill Mann/R4/USEPA/US]

McManus, Fred

From: McManus, Fred
Sent: Wednesday, May 29, 2013 8:04 AM
To: 'Combs, Marvin (EEC)'
Subject: Hart Oil, LLC Public Hearing
Attachments: Hart Oil Public Hearing Statement 5 14 13wc changes.docx

Marvin, my opening and closing statements are attached. Also, as you requested, the State Permit Number for the injection well is 102267.

Thanks and hope you have a good day,

Fred

Public Hearing

Proposed Termination of UIC Permit KYI0891 – Hart Oil, LLC

**Assembly Room – Adair County Annex Building
424 Public Square, Columbia, Kentucky**

May 30, 2013 - 6:00-8:00 p.m. CDT

Opening Statement:

Good evening and welcome! I am Fred McManus, Chief of the Ground Water and Underground Injection Control Section, Safe Drinking Water Branch, U.S. Environmental Protection Agency, Region 4 in Atlanta, Georgia. Also attending from Region 4 is Wilda Cobb, Associate Regional Counsel, and Jim Ferreira, Hydrologist/Geologist on my staff with responsibility for writing Class II Underground Injection Control permits.

The hearing shall come to order.

EPA is conducting a public hearing today on the “proposed” termination of the Underground Injection Control Permit KYI0891 under the authority of Title 40 of the Code of Federal Regulations Parts 124, 144, 146 and 147. The subject permit was issued to Hart Oil, LLC, with a business address of 399 Calvert Church Lane, Leitchfield, Kentucky. The subject permit is for the conversion, operation, plugging and abandonment of the injection well, Chat Chowning #3, located in Crocus Creek Field, Cumberland County, Kentucky, with a Carter Coordinate of 23-F-51, 877’ FNL and 1,604’ FEL.

Comments and all other information received today will be considered by EPA, Region 4 in making its final decision and will become part of the administrative record.

Notice of this public hearing was published in a local newspaper, the Adair Progress, located in Columbia, Kentucky on Thursday, April 18, 2013.

The Public notice was also mailed or emailed to other interested parties. **The purpose of this public hearing is to allow interested persons the opportunity to make oral or submit written comments and provide any other information on the “proposed” termination of the Underground Injection Control Permit KYI0891.**

For your information, I would like to provide the following background information:

On December 30, 2008, the EPA issued a public notice of its Intent to Issue UIC Permit No. KYI0891 to Hart Oil, LLC. The permit was issued on February 11, 2009. The EPA subsequently issued a public notice of Intent to Terminate the permit in a notice dated December 11, 2012, for cause under 40 Code of Federal Regulations § 144.40 (2) **due to the failure of the permittee to disclose the presence of a fault or joint and fracture system in the area of review**, a potential source or migration pathway for contaminants into an underground source of drinking water. The potential contaminants, that could migrate into an underground source of drinking water, as a result of the permitted activity, include benzene, a neurotoxicant which would endanger human health and the environment.

Note that this hearing is being recorded by a video and audio recording device. We will hold the transcript of the hearing as well as any written comments and other information received as a matter of public record at the EPA Regional Office in Atlanta, Georgia; this information will become part of the administrative record.

Since this public hearing is being held more than 30 days after the Public Notice was published in the Adair Progress, the public comment period will end at the conclusion of this hearing.

Tonight's hearing is a formal non-adversarial hearing providing interested parties with the opportunity to make oral comments and to submit written comments on the proposed UIC permit termination. There will be no cross examination of either the EPA staff or the commenters. Any questions

directed to a commenter from an EPA staff member will be for clarification purposes only.

Any and all persons present and desiring to make oral or written comments and submit other information will be allowed to do so. In order to allow all participants time to express their views tonight, I ask that you limit your comments to ten minutes. If you do not finish your comments in the allotted time I will ask that you defer the remainder of your comments until each person has had an opportunity to comment. Then, if there is time at the end of the meeting we will give you an opportunity to finish your comments.

I will ask each person making a statement or submitting written comments or other information to step forward when I call your name. I ask that you state your name for the record, spell it if necessary, and state your interest or the organization you are representing.

Before we proceed with oral comments and the submission of written comments and other information, I would like to **recognize any local or state elected officials** who would like to make a statement. (Pause, receive statements from elected officials).

Now, we'll proceed with the statements of registered persons who would like to make comments and submit other information. As you come forward, please remember to state your name, spell it if necessary, and state your interest or the organization you are representing.

Closing Statement:

I want to thank each of you for your participation in this public hearing. As previously stated, the comments and other information received today will be carefully considered and evaluated as we make our determination regarding the proposed action. As previously mentioned, the public comment period will end at the conclusion of this hearing. All those that made oral comments or submitted written comments or other information by the close of this hearing will have their names added to our mailing list.

I would like to ask everyone here who **did not register** before entering the conference room, to please do so before you leave.

EPA will prepare a document known as a Response to Comments that will describe and address the significant issues raised during the comment period. The Response to Comments will accompany the final permit termination decision for the Hart Oil, LLC UIC permit. Notice of the availability of the Response to Comments and the final permit decision will be mailed or e-mailed to everyone who commented on the permit termination.

Anyone who wishes to contest the Final Permit must file a petition for review or appeal with the Environmental Appeals Board, also known as the EAB. A couple of important things to remember if you are considering appealing the EPA's final permit decision:

First, the petition for review or appeal must be received by the EAB within 30 days of the date the final permit decision is issued.

Second, only persons who filed comments on the proposed termination of the permit during the public comment period, or who provided comments during the hearing tonight may petition the EAB to review the final permit decision.

Third, any person seeking to review a permit decision must raise all reasonably ascertainable issues and submit all reasonably available arguments supporting their position during the public comment period, including this public hearing. Issues or arguments that are not raised will not be considered by the EAB on appeal.

Thank you again for your participation. Let the record show that this hearing is adjourned at _____ CDT.



Florida Department of Environmental Protection

Bob Martinez Center
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

RECEIVED

May 3, 2010

MAY 03 2010

UIC PROGRAM

Mr. E. Stallings Howell, Chief
Safe Drinking Water Branch
US EPA Region 4
61 Forsyth Street, S.W.
Atlanta, GA 30303-8960

Dear Mr. Howell:

In July 2005, the Florida Department of Environmental Protection (Department) submitted a position paper titled Permitting Increased Arsenic Levels at Aquifer Storage and Recovery (ASR) Facilities to the US Environmental Protection Agency (EPA). The paper addressed the conditions under which arsenic would be allowed to exceed 10 µg/L and included requirements for preventing the human consumption of that water. The Department still believes that the position paper addressed endangerment under Section 1421 (d)(2) of the Safe Drinking Water Act. The Department never received a response from EPA.

Because concurrence with the position paper was not received from EPA, the DEP issued Program Guidance Memo WRM/GW-08-01 on April 11, 2008, that outlined the process for regulating ASR facilities with increased levels of arsenic. The memo employed Department permitting and enforcement procedures that were approved by EPA in Florida's Underground Injection Control program submittal package. The Guidance Memo requires Consent Orders or Administrative Orders be issued to ASR facilities that exceed or are reasonably expected to exceed the arsenic level of 10 µg/L in recovered water or at any monitoring well.

At the November 2009 EPA State Director's Meeting held in Guntersburg, Alabama, EPA Region 4 suggested the Department resubmit a paper addressing non-endangerment for reconsideration by Region 4. The Department offers the enclosed Non-Endangerment Proposal, Permitting Aquifer Storage and Recovery Facilities with Increased Arsenic Levels. This proposal is very similar to the original position paper; with changes reflecting data and knowledge we have gained in the last 5 years of testing and operating ASR facilities.

Aquifer Storage and Recovery is an important tool in Florida's water supply strategy, providing a safe and secure alternative to the above ground reservoir for the storage of surface and ground water, and reclaimed water. Without cost effective storage options the wastewater utilities in the state will need to dispose of reclaimed waters down Class I wells or to tide. Drinking water utilities will need to draw on the finite water resources of the state. This strategy protects the

public health and provides a valuable water supply alternative. We appreciate your consideration of the enclosed strategy and welcome any suggestions you may have to make this work.

Sincerely,

A handwritten signature in black ink, appearing to read 'Richard Drew', with a stylized flourish at the end.

Richard Drew
Chief
Bureau of Water Facilities Regulation

RDD/dm

Enclosure

Non-Endangerment Proposal

Permitting Aquifer Storage and Recovery Facilities With Increased Arsenic Levels

Issue

With the lack of natural reservoirs in Florida for storage, and the growing demand for water for drinking and other uses, aquifer storage and recovery (ASR) using the aquifer as a water storage area is increasingly being explored. This paper examines the issues of arsenic being found in the subsurface (not in the injectate) and proposes solutions to allow ASR to be permitted by requiring stringent controls to protect the ground water as a drinking water source and to protect public health.

Every ASR project in Florida is required to meet the primary drinking water standard for arsenic of 10 µg/L (lowered from 50 µg/L in 2006) in its injectate. However, even though the water being injected meets the arsenic standard, the quality of the recovered water at the majority of ASR facilities has frequently exceeded the new standard of 10 µg/L during its testing and operation. Existing regulations do not take into account the water-rock interactions caused by injection and recovery operations.

Although not much arsenic data has been obtained from ASR storage zone monitor wells at the older ASR facilities, the data obtained from recent ASR facilities indicates that the duration of the exceedances for arsenic in storage zone monitor wells is not as long as that observed in the ASR well during recovery. Data indicate that exceedances of arsenic at any given point in the aquifer more than a few hundred feet from the ASR well are minimal in both duration and concentration. In no case has water with greater than 10 µg/L of arsenic been delivered by a utility to the public.

It is also believed that the increased arsenic levels are transient in nature and will decrease over time under consistent operating conditions. Existing recovery data indicate arsenic levels in the recovered water are generally lower for facilities that have been operational for a long time, whereas increased levels usually occur at newly operational ASR facilities.

Applicable Regulations

ASR wells are permitted as Class V injection wells under the Underground Injection Control (UIC) Program. These activities are governed by state and federal UIC regulations and the Safe Drinking Water Act. The primary issue under these regulations is the interpretation of endangerment to an underground source of drinking water (USDW – generally ground water with a total dissolved solids content of less than 10,000 mg/L). The construction or operation of an injection well must not endanger a USDW.

Proposal

The Department offers the following proposal to address endangerment. Arsenic levels may exceed 10 µg/L within the ASR storage zone under the following conditions:

1. The ASR storage zone over the entire area of review (plus a 50% safety factor or one mile, whichever is greater) contains a total dissolved solids (TDS) concentration of 10,000 mg/L or more; or

Onsite

2. A concentration of 10 µg/L is not exceeded at the property boundary; or

Offsite

- 3.a. The ASR storage zone over the entire area of review contains a TDS concentration of 3,000 mg/L or more and a Professional Engineer certifies that the treatment necessary to render the natural water potable will also reduce the arsenic level to 10 µg/L or less, or institutional controls are in place that prohibit the construction of new drinking water wells used to withdraw water from the ASR storage zone, and there are no existing wells used to withdraw drinking water from the ASR storage zone within the area of review; or
- 3.b. The ASR storage zone over part of the area of review contains a TDS concentration of less than 3,000 mg/L and institutional controls are in place that prohibit the construction of new drinking water wells used to withdraw water from the ASR storage zone, and there are no existing wells used to withdraw drinking water from the ASR storage zone within the area of review; and

All Facilities

4. Any recovered water is retreated or blended as necessary to meet the federal and state water quality standards applicable to the intended use of the recovered water.

The above requirements should provide adequate assurance that there will be no pathway for human consumption of water that exceeds the 10 µg/L MCL for arsenic. This meets the non-endangerment requirements of both the UIC regulations and the Safe Drinking Water Act.

Application to Aquifer Recharge Projects

The risk-based strategies contained in this paper may be applicable to aquifer recharge projects, where water is injected to recharge an aquifer without recovery of the same water. These projects may include recharge of aquifers with reclaimed

water; salt water barrier injection with reclaimed water; or recharge with surface water in order to offset production of water from the same aquifer in another location. As these projects are proposed and permitted, research will be necessary to determine the best ways to establish guidance for potential arsenic mobilization issues.

**PROGRAM GUIDANCE MEMO
WRM/GW-09**

TO: Water Facilities Administrators

FROM: Janet G. Llewellyn, Director
Division of Water Resource Management

DATE: July 15, 2009

SUBJECT: Process for Regulating Aquifer Storage and Recovery Facilities (ASR)
with Increased Levels of Arsenic

PURPOSE

The purpose of this paper is to outline the process for permitting ASR facilities where arsenic levels have exceeded or may exceed 10 µg/L, in either the recovered water or monitoring wells, and the corrective action process when exceeding the standard.

ISSUE

The Underground Injection Control (UIC) program has seen a growing interest in the use of Class V, aquifer storage and recovery systems in Florida. It is an attractive solution for the utility looking to expand its storage capability. Land costs are minimal; security costs associated with above ground storage tanks and reservoirs are greatly reduced; and, the geology of many areas in the state allows viable recovery of injected water.

Federal and state UIC regulations require all injected water to meet primary drinking water standards. One such standard, Arsenic (As), is the focus of this guidance. Effective January 26, 2006, the federal primary drinking water standard for arsenic decreased from 50 µg/L to 10 µg/L. The standard change, by itself, is not an issue since data has shown water injected at all ASR operations in Florida meets the new As standard; in fact, As is usually not even detected in injected water. However, the water recovered from many of the ASR facilities in the state and, in some cases, ground water in monitor wells in the ASR zone exceeds the drinking water standard of 10 µg/L. (It should be understood that no utility has been shown to deliver water in excess of the 10 µg/L standard to their customers.)

Even though As concentrations injected into the well are below the standard, the federal regulations at 40 CFR 144.12 (a) state:

No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into underground sources of drinking water, if the presence of that contaminant may cause a violation of

any primary drinking water regulation under 40 CFR part 142 or may otherwise adversely affect the health of persons.

This is interpreted to mean that even if the arsenic is derived from the interaction of injected fluids with the *in situ* geology, it is still considered to be a violation of federal drinking water law.

BACKGROUND

Arsenic is a naturally occurring element present in some sulfide-bearing minerals found in the aquifers used for ASR storage zones in Florida. Under the natural, low oxygen conditions normally found in the ground water, the arsenic remains bound in the rock matrix. However, in the more oxygen-rich water injected for an ASR system, an oxidative reaction is thought to cause arsenic to go into solution.

Sixteen out of 33 ASR facilities injecting into an Underground Source of Drinking Water have collected operational data on arsenic concentrations in a monitor well or in the recovered water. All sixteen of those facilities had one or more arsenic exceedance of 10 µg/L, with 10 facilities measuring at least one arsenic concentration of greater than 50 µg/l.

The Department's Florida Geological Survey (FGS) has conducted geochemical analyses of rocks and ground water at a variety of ASR test sites throughout the state. The source of arsenic has been identified as being released from the rock matrix upon the introduction of injected water. The study is currently focusing on the mechanics of the process.

In addition, FGS participated with a National Academy of Sciences workgroup to develop a summary of research efforts on the subject of Managed Underground Storage of Recoverable Water. This report was completed in October 2007.

The U.S. EPA has determined that ASR is a national issue and not just specific to Florida. They have established a national EPA workgroup to develop a report describing ASR practices and problems from a national perspective. This report has yet to be finalized.

The results of these efforts may modify the way ASR systems are regulated, but until changes are placed into the Federal regulations or guidance, we must assume that an exceedance in the recovered water or a monitor well (of a primary drinking water quality standard) is a violation of the UIC regulations. Where an exceedance is observed the facility must take steps to come back into compliance.

One way this could be achieved is by pretreatment of the injectate to bring it into a reduced state. Pilot projects will soon be started at the City of Bradenton, City of Sanford, and Seminole County potable water ASR facilities to examine the effectiveness of this type of pretreatment. A system is being built that is designed to remove nearly all

of the dissolved oxygen prior to the injection of water (a process called degasification). The expectation is that the water with a low dissolved oxygen concentration will not cause the release of arsenic from the arsenic-bearing minerals in the ASR zone, and that ground water will not exceed the arsenic regulatory standard.

In addition, several utilities are proposing to inject low dissolved oxygen water from the lower Surficial aquifer and upper Floridan aquifers into deeper portions of the Floridan aquifer to examine if the process is sufficient to avoid leaching of the arsenic from the formation into the ground water.

GENERAL PROCESS AND RATIONALE

An Administrative Order will be issued with a permit or upon permit renewal for facilities that were either permitted or operating under a Letter of Authorization to Use (LOATU) prior to January 26, 2006, if arsenic levels have exceeded 10 µg/L but have not exceeded the previous arsenic standard of 50 µg/L in the recovered water or a monitoring well.

Rationale: When a facility has been in compliance with its permit (or LOATU) and a standard changes an Administrative Order is the appropriate mechanism to use at the time of permit renewal to provide additional time for the facility to comply with the new standard.

A Consent Order will be negotiated for any facility where arsenic levels have exceeded 50 µg/L in the recovered water or a monitoring well regardless of when they were permitted or authorized to operate under a LOATU.

Rationale: When a facility exceeds both an old and new standard, a Consent Order (enforcement tool) is appropriate to get the facility into compliance.

A Consent Order will be negotiated for facilities that were permitted on or after January 26, 2006, if arsenic levels have exceeded 10 µg/L in the recovered water or a monitoring well.

Rationale: When a facility exceeds a new standard that is specified in the permit, a Consent Order (enforcement tool) is appropriate to get the facility into compliance.

Facilities that are implementing arsenic monitoring under a permit condition or LOATU but have not detected arsenic exceeding 10 µg/L in the recovered water or a monitor well may continue operating under their current permit or LOATU.

Rationale: An Administrative or Consent Order is not needed because there is no violation.

When determining if an Administrative Order or Consent Order is needed, exceedances will be determined based on data that reflects recent conditions and trends regarding arsenic concentrations in monitor wells or recovered water.

PERMITTED FACILITIES

The flow chart in Figure 1 outlines the process to be used for permitted facilities or facilities applying for a permit.

Permit issued on or after January 26, 2006

Facilities that are implementing arsenic monitoring under a permit condition but have not detected arsenic exceeding 10 µg/L in the recovered water or a monitor well may continue operating under their current permit.

A Consent Order will be negotiated for facilities where arsenic has exceeded 10 µg/L in the recovered water or a monitor well. Facilities currently under a construction permit will remain under a construction permit (rather than an operation permit) until the facility can demonstrate compliance with the arsenic standard.

Facilities that have not begun cycle testing, and therefore arsenic concentrations are not known, may request an Administrative Order through a major permit modification.

Permit issued prior to January 26, 2006

Facilities currently not monitoring for arsenic under a permit condition shall be required under a minor permit modification to sample for arsenic in the recovered water and any monitor wells associated with the facility.

Facilities that are implementing arsenic monitoring under a permit condition (including a minor permit modification) but have not detected arsenic exceeding 10 µg/L in the recovered water or a monitor well may continue operating under their current permit.

An Administrative Order shall be issued at permit renewal for facilities where arsenic has exceeded 10 µg/L but is less than or equal to 50 µg/L in the recovered water or a monitor well. However, there may be site-specific concerns that would necessitate reopening and reissuing a permit with an Administrative Order prior to permit expiration. Site-specific concerns would include continued increases in arsenic concentration, impact to an on-site drinking water source, or an arsenic exceedance of 10 µg/L off-site (beyond the facility's property boundary).

A Consent Order must be negotiated for any facility where arsenic has exceeded 50 µg/L.

FACILITIES CURRENTLY OPERATING UNDER A LETTER OF AUTHORIZATION TO USE (LOATU)

The flow chart in Figure 2 outlines the process to be used for facilities currently operating under a LOATU.

Facilities not monitoring for arsenic shall be required to initiate monitoring of the recovered water and any monitor wells associated with the facility. No new monitor wells will be required at this stage.

A LOATU shall be rescinded for any facility where arsenic has exceeded 50 µg/L in the recovered water or a monitor well and the facility must obtain an operating permit and negotiate a Consent Order.

A LOATU shall be rescinded for any facility where arsenic has exceeded 10 µg/L but less than or equal to 50 µg/L in the recovered water or a monitor well and the facility must obtain an operating permit with an Administrative Order. These facilities may also be required to install additional monitor wells to determine the extent of the exceedance. Based on this monitoring, the absence of arsenic exceedances may serve as a basis for a reduction in monitoring frequency.

Facilities not detecting arsenic exceeding 10 µg/L in the recovered water or a monitor well may continue operating under their LOATU.

ASR FACILITIES APPLYING FOR AN INITIAL PERMIT OR WHOSE APPLICATIONS ARE NOT DEEMED COMPLETE (AFTER THE EFFECTIVE DATE OF THIS GUIDANCE)

New ASR facilities applying for an initial permit will be issued a construction permit and shall be required to conduct cycle tests to determine if a potential for increased arsenic levels exists. A cycle test is an aquifer storage and recovery (ASR) sequence which typically consists of three distinct phases of operation - an injection or recharge phase; a storage phase; and a recovery or retrieval phase - conducted for the purpose of testing the ASR system to determine its geochemical and physical properties. If the facility is located in an area where existing hydrogeologic data is not sufficient to target the ASR zone or provide adequate ground water quality information, a facility may be required to first construct an exploratory well.

An Administrative Order should be required with the construction permit when the applicant cannot provide sufficient information to demonstrate that arsenic will not exceed 10 µg/L in the recovered water or a monitor well. However, if the applicant cannot provide reasonable assurance that arsenic will not exceed 10 µg/L off-site, the permit shall be denied.

If an Administrative Order is not required with a construction permit and arsenic is detected exceeding the 10 µg/L in the recovered water or a monitor well, a Consent Order

will be negotiated. Facilities not exceeding 10 µg/L will be issued an operating permit at the end of the construction and testing phase.

PURPOSE AND PROCESS FOR ADMINISTRATIVE ORDERS AND CONSENT ORDERS

Purpose of an Administrative Order

An Administrative Order may accompany the issuance or renewal of a permit in accordance with Section 403.088(2)(e) and (f), F.S. An Administrative Order allows, in this case, an ASR facility to operate even if noncompliance with the arsenic standard should occur as long as steps (contained in the Administrative Order) are established in a schedule for achieving compliance with all permit conditions. Interim limits, contained in the Administrative Order, provide restrictions on the discharge until compliance is achieved under the terms of the Administrative Order. An Administrative Order is used when the Department lacks reasonable assurance that the arsenic standard will be met, yet has no direct evidence of a violation, or if a new effluent limit is placed in the permit and the facility must make changes to comply. The Administrative Order shall not be granted for more than 5 years and coincide with the duration of the accompanying permit.

An Administrative Order is no longer needed when a permittee can meet all permit conditions. The permit may be modified to remove all references to the Administrative Order, or if close to permit renewal, the renewed permit will be issued without an Administrative Order.

Purpose of a Consent Order

A Consent Order is an enforcement tool and is issued independent of a permit, and is used when a violation of a permit or regulatory limit has occurred. The Consent Order outlines corrective actions necessary for the permittee to return to compliance. Like the Administrative Order, the Consent Order contains conditions to return the facility to compliance or to cease operation within a time certain. While compliance is being sought, the Consent Order includes conditions for the protection of public health.

The Consent Order should contain conditions that would be similar to those contained in an Administrative Order, for example:

- Cycle testing to determine if a decrease in arsenic level will occur with subsequent cycles
- Evaluation of monitor plan adequacy
- Pretreatment of the injectate
- Changes to operation procedures
- Remediation of the affected ground water such as withdrawal of the injected water
- Institutional controls to restrict access to affected waters
- Plugging and abandonment of the well if all else fails

The Department shall notify by warning letter each ASR facility that will be required to obtain a Consent Order in order to continue ASR operations. While it is recommended to have the facilities receiving a warning letter cease operation until a Consent Order is negotiated and in effect, there may be circumstances that warrant continued operation during the negotiation process. The need to cease operation until a Consent Order is executed is left to the Department's discretion. One example or reason for continued operation would be where a pretreatment technology is being tested.

Process and Content of a Consent Order

The UIC rules require two separate public participation/notice steps. The first is the 30-day comment period and opportunity for a public meeting on a draft Consent Order. This step takes place before the consent order is proposed agency action, and is before the Respondent has actually signed the order, but has agreed to its content. The notice to be published by the Respondent in a newspaper of general circulation in the area of the project is called the Notice of Draft Consent Order. This Notice shall be sent to the Respondent for publication as soon as the Respondent agrees to the Consent Order. The second step is the Florida-only required 21-day period for a substantially affected person to request a hearing on the proposed agency action. That notice to be published along with the publication requirements are part of the Consent Order.

For an extension of a permit issued for less than 5 years, the extension may be granted but must contain a condition that the facility will make every effort to negotiate and finalize a consent order with the Department within one year from the date of the extension. If the consent order is not entered in that one-year period and there is no legitimate reason for the delay, the Department will begin the permit revocation process.

When a consent order is required, it must be entered before a permit is renewed.

Duration of a Consent Order

Operation of an ASR facility which exceeds 10 µg/L in the recovered water or a monitor well shall be allowed for a period of time based on the corrective action alternative(s) proposed. The duration allowed under a Consent Order shall be negotiated with the facility on a case-by-case basis, and shall be typically limited to the expiration date of the facility's current permit with a possible extension for an additional permit cycle. Facilities proposing corrective action measures in addition to cycle testing to allow arsenic levels to decrease may be allowed additional time to implement those measures. A Consent Order "ends" when Respondent complies with its conditions.

ADDITIONAL REQUIREMENTS FOR OFF-SITE ARSENIC EXCEEDANCES

Facilities with arsenic suspected or detected exceeding 10 µg/L off-site shall be required to take any action necessary to ensure non-endangerment to public health and safety.

Any order issued shall require the implementation of a non-endangerment action plan that shall address the following:

- An estimate of the vertical and lateral extent of arsenic concentration exceeding 10 µg/L that may require the installation of additional monitoring wells.
- A field-verified inventory of all water wells within the area determined by best professional judgment to include the area potentially affected by the discharge plus a safety factor such as 50%, or a one-mile radius, whichever is larger (area of review)
- Provisions for alternate water supplies for water wells within the area of review
- Measures that will be taken to remove off-site contamination or risk-based corrective action the facility will conduct under Chapter 62-780, F.A.C., including Department-approved institutional controls in accordance with the Division of Waste Management's Institutional Controls Procedures Guidance, November 2004, to prevent the construction or use of water wells within areas of off-site contamination. The Department also shall accept a local government's ordinance as an institutional control if that ordinance prohibits the construction or use of water wells within areas of off-site contamination.
- The facility may be required to sample off-site wells identified within the area of review that withdraw from the storage zone
- The Department will notify all property owners of off-site wells likely to exceed the arsenic standard

Attachments

McManus, Fred

From: Haberfeld, Joe [Joe.Haberfeld@dep.state.fl.us]
Sent: Thursday, February 28, 2013 1:15 PM
To: McManus, Fred
Subject: RE: Peace River Water Quality Criteria Exemption, Final Order

It appears to be March 2, 1984, although it covered only the first few wells. Numerous permits have been issued for the rest of the wells.

From: McManus, Fred [<mailto:Mcmanus.Fred@epa.gov>]
Sent: Thursday, February 28, 2013 12:57 PM
To: Haberfeld, Joe
Subject: RE: Peace River Water Quality Criteria Exemption, Final Order

Also, when did FDEP Issue the original ASR Permit to Peace River Manasota Regional Water Supply Authority?

Thanks again,

Fred

From: Haberfeld, Joe [<mailto:Joe.Haberfeld@dep.state.fl.us>]
Sent: Thursday, February 28, 2013 12:53 PM
To: McManus, Fred
Subject: RE: Peace River Water Quality Criteria Exemption, Final Order

The other WQCE's were issued for secondary standards, with color and odor being most common. Aluminum and iron have been included a few times.

From: McManus, Fred [<mailto:Mcmanus.Fred@epa.gov>]
Sent: Thursday, February 28, 2013 12:47 PM
To: Haberfeld, Joe
Subject: RE: Peace River Water Quality Criteria Exemption, Final Order

Thanks Joel What did you say the other WQCE's were issued for?

Fred

From: Haberfeld, Joe [<mailto:Joe.Haberfeld@dep.state.fl.us>]
Sent: Thursday, February 28, 2013 12:35 PM
To: McManus, Fred
Subject: FW: Peace River Water Quality Criteria Exemption, Final Order

Please take a few minutes to share your comments on the service you received from the department by clicking on this link [DEP Customer Survey](#).

From: Haberfeld, Joe
Sent: Thursday, February 28, 2013 11:48 AM

To: 'Marsh.Nancy@epamail.epa.gov'

Subject: Peace River Water Quality Criteria Exemption, Final Order

Here you go.

McManus, Fred

From: Haberfeld, Joe [Joe.Haberfeld@dep.state.fl.us]
Sent: Thursday, February 28, 2013 12:35 PM
To: McManus, Fred
Subject: FW: Peace River Water Quality Criteria Exemption, Final Order
Attachments: Peace River Signed Final 13.pdf

Please take a few minutes to share your comments on the service you received from the department by clicking on this link [DEP Customer Survey](#).

From: Haberfeld, Joe
Sent: Thursday, February 28, 2013 11:48 AM
To: 'Marsh.Nancy@epamail.epa.gov'
Subject: Peace River Water Quality Criteria Exemption, Final Order

[Here you go.](#)



**FLORIDA DEPARTMENT OF
ENVIRONMENTAL PROTECTION**
BOB MARTINEZ CENTER
2800 BLAIRSTONE ROAD
TALLAHASSEE, FLORIDA 32399-2400

**RICK SCOTT
GOVERNOR**

**JENNIFER CARROLL
LT. GOVERNOR**

**HERSCHEL T. VINYARD JR.
SECRETARY**

ELECTRONIC CORRESPONDENCE

February 12, 2013

Patrick J. Lehman, P. E.
Peace River Manasota Regional Water Supply Authority
9415 Town Center Parkway
Lakewood Ranch, Florida 34202
PLehman@regionalwater.org

**RE: Final Order Granting a Water Quality Criteria Exemption to the Peace River Manasota
Regional Water Supply Authority, Peace River ASR Facility, DeSoto County, Florida**

Dear Mr. Lehman:

Enclosed is a signed copy of the Department's Final Order granting a Water Quality Criteria Exemption from the groundwater standard for arsenic associated with Class V underground injection control operation Permit Number 0136595-014-UO pursuant to Rule 62-520.500, Florida Administrative Code (F.A.C.). The exemption is for the Peace River Manasota Regional Water Supply Authority's Peace River Aquifer Storage and Recovery facility, DeSoto County, Florida.

Please call me at 850/245-8655 or contact me at Joe.Haberfeld@dep.state.fl.us if you have any questions or need assistance.

Sincerely,

Joseph Haberkfeld, P.G.
Professional Geologist
Underground Injection Control Program

JH/

Enclosures

Patrick J. Lohman, P. E.

Page 2

February 12, 2013

cc: Mike Coates, P.G., Peace River Manasota Regional Water Supply Authority
Mark McNeal, P.G., ASR-US, LLC
Craig Varn, Manson Law Group
Mauryn McDonald, DEP/Tampa
Rommy Lahera-Aument, DEP/Tampa
Betsy Hewitt, DEP/Tallahassee
Greg DeAngelo, DEP/Tallahassee
James Alexander, DEP/Tallahassee
Blake Gullory, Southwest Florida WMD
Ann Shortelle, Suwannee River WMD

**STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION**

In re:
Petition for Class G-II Ground Water
Quality Criteria Exemption
Peace River Manasota Regional
Water Supply Authority
Aquifer Storage and Recovery Facility

OGC File No. 12-1502
Desoto County

**FINAL ORDER
GRANTING A WATER QUALITY CRITERIA EXEMPTION**

The Department of Environmental Protection hereby issues a Final Order granting a ground water quality criteria exemption for arsenic pursuant to Rule 62-520.500, Florida Administrative Code (F.A.C.), to the Peace River Manasota Regional Water Supply Authority (the "Authority"), 9415 Town Center Parkway, Lakewood Ranch, Florida 34202, as set forth below.

BACKGROUND AND FINDING of FACTS

1. On August 20, 2012, the Department received a petition from the Authority for a water quality criteria exemption for an installation discharging into Class G-II ground water pursuant to Rule 62-520.500, F.A.C. The installation is Authority's Aquifer Storage and Recovery (ASR) wellfields, designated as Wellfield 1 and Wellfield 2, located at 8998 SW County Road 769 in Desoto County, Florida.

2. The Authority is currently authorized to inject potable water which has received full treatment from the on-site drinking water treatment plant to ground water under Underground Injection Control (UIC) Operation Permit Number 0136595-005-UO

(Wellfield 1) and UIC Construction Permit Number 0136595-010-UC (Wellfield 2), and, if issued, under future UIC Operation Permit Number 0136595-014-UO for Wellfields 1 and 2.

3. The Authority's petition requested an exemption from the ground water standards contained in Rule 62-520.420(1), F.A.C., which are the same as the drinking water standards in Rules 62-550.310 and 62-550.320, F.A.C. Specifically, the petition requested an exemption from the primary drinking water standards for the arsenic standard of 0.010 mg/L. The petition requests that the ASR system be operated such that the arsenic concentration does not exceed 0.010 mg/L at the property boundary of land owned by the Authority or at the boundary of easements granted to the Authority by the Southwest Florida Water Management District.

4. The Department reviewed the Authority's petition for a water quality criteria exemption and determined that the petition meets the six criteria for issuance of an exemption pursuant to Rule 62-520.500(1), F.A.C., as more fully described in the Intent to Grant.

5. On December 12, 2012, the Department signed an Intent to Grant the ground water quality criteria exemption for arsenic to the Authority under Rule 62-520.500, F.A.C. A copy of the Intent to Grant is attached as Exhibit I.

6. On December 14, 2012, the Department sent a cover letter and the executed Notice of Intent to Grant, notifying the Petitioner of the Department's proposed agency action and advising the Petitioner of the right to a hearing pursuant to sections 120.569 and 120.57, Florida Statutes (F.S.).

7. As required by the Intent to Grant, pursuant to section 403.815, F.S., and Rules 62-110.106(7) and 62-520.500(3), F.A.C., the Petitioner published notice on January 9, 2013, in the *Charlotte Sun*, a daily newspaper published in Charlotte County, Florida, with general circulation in the facility area. A copy of the newspaper notice and proof of publication are attached as Exhibit II.

8. The Department published notice of the Intent to Grant on December 14, 2012, in the *Florida Administrative Register* informing the public of the Department's intended action and offering an opportunity for hearing pursuant to sections 120.569 and 120.57, F.S. A copy of the notice is attached as Exhibit III.

9. The Petitioner and interested parties, having been advised of their rights under Chapter 120, F.S., and having failed or declined to file a petition pursuant to sections 120.569 and 120.57 F.S., are hereby deemed to have waived those rights.

IT IS THEREFORE ORDERED that the Peace River Manasota Regional Water Supply Authority petition for an exemption from the drinking water standard for arsenic set forth in Rule 62-550.310, F.A.C., for the ground waters specified herein is hereby GRANTED, subject to these conditions:

(a) The ground water quality exemption is being granted in part based on the Department's understanding that the Petitioner's ASR operation will not present a danger to the public health, safety, or welfare and will not result in any adverse environmental, social, or economic effects.

(b) The exemption is granted for the duration of the Authority's UIC Permit Number 0136595-014-UO for ASR Wellfields 1 and 2. Future exemptions must be petitioned for by the applicant in conjunction with a renewal of the operation permit or

another UIC permit for any other injection wells at the facility. The exemption extends only to ground water elements of the Authority's UIC permit. The exemption will not affect any discharge regulated under the Clean Water Act to surface waters of the state, nor will it alter any permit conditions related to surface water.

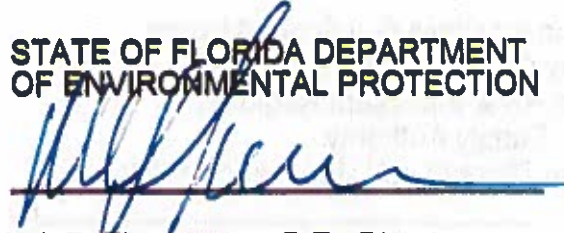
(c) The exemption provides relief only from the arsenic standard contained in Rule 62-550.310, F.A.C., as referenced in Rule 62-520.420, F.A.C. All other ground water quality standards, including the minimum criteria contained in Rule 62-520.400, F.A.C., apply to this project.

(d) The permittee shall monitor water quality in accordance with the specific conditions of the Underground Injection Control Permit Number 0136595-014-UO, if issued.

A party to this order has the right to seek judicial review of it under section 120.68, F.S., by filing a notice of appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with the clerk of the Department in the Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida 32399-3000, and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice must be filed within thirty days after this order is filed with the clerk of the Department.

DONE AND ORDERED this 12th day of February 2013, in Tallahassee,
Florida.

STATE OF FLORIDA DEPARTMENT
OF ENVIRONMENTAL PROTECTION



Mark P. Thomasson, P.E., Director
Division of Water Resource Management
State of Florida Department of
Environmental Protection
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

FILING AND ACKNOWLEDGMENT

FILED ON THIS DATE, PURSUANT TO §120.52,
FLORIDA STATUTES, WITH THE DESIGNATED
DEPARTMENT CLERK, RECEIPT OF WHICH IS
HEREBY ACKNOWLEDGED.

 2/12/13
CLERK DATE

Copies furnished to:

Patrick J. Lehman, P.E., Peace River Manasota Regional Water Supply Authority
Mike Coates, P.G., Peace River Manasota Regional Water Supply Authority
Mark McNeal, P.G., ASR-US, LLC
Craig Varn, Manson Law Group
Mauryn McDonald, DEP/Tampa
Rommy Lahera-Aument, DEP/Tampa
Greg DeAngelo, DEP/APP
James Alexander, DEP/APP
Betsey Hewitt, DEP/OGC
Blake Guillory, Southwest Florida WMD
Ann Shortelle, Suwannee River WMD

Enclosures: (3)

EXHIBIT I

STATE OF FLORIDA DEPARTMENT OF ENVIRONMENTAL PROTECTION

**In re:
Petition for Class G-II Ground Water
Quality Criteria Exemption
Peace River Manasota Regional
Water Supply Authority
Aquifer Storage and Recovery Facility**

**OGC File No. 12-1502
Desoto County**

INTENT TO GRANT GROUND WATER QUALITY CRITERIA EXEMPTION

The Department of Environmental Protection gives notice of its intent to grant a ground water quality criteria exemption under Rule 62-520.500, Florida Administrative Code (F.A.C.), to the Peace River Manasota Regional Water Supply Authority (the "Authority"), 9415 Town Center Parkway, Lakewood Ranch, Florida 34202, as detailed in its petition, OGC file number 12-1502. The Department is issuing this intent for the reasons stated below.

BACKGROUND, FACTS, AND CIRCUMSTANCES

1. On August 20, 2012, the Department received a petition from the Authority's representative, the Manson Law Group, for a water quality criteria exemption for an installation discharging into Class G-II ground water pursuant to Rule 62-520.500, F.A.C. The petition coincided with the Authority's application for an underground injection control (UIC) operation permit for its Aquifer Storage and Recovery (ASR) wellfields, designated as Wellfield 1 and Wellfield 2, located at 8998 SW County Road 769 in Desoto County, Florida. The Authority operates a total of twenty-two ASR wells. Twenty of these wells, which inject fluid into the Suwannee Limestone geologic formation, are included in the exemption request; eight ASR wells in Wellfield 1 and

twelve ASR wells in Wellfield 2. ASR well T-1 is completed in the Tampa Formation and ASR well AP-1 is completed in the Avon Park Formation and are not part of this exemption request. The ASR wells inject potable water, which has received full treatment at the Authority's on-site drinking water treatment plant, into underground geologic formations for storage and subsequent recovery. The Suwannee Limestone geologic formation is part of the Floridan aquifer system located at depths of 500 to 950 feet below land surface in the vicinity of the ASR wells. This formation is considered a Class G-II aquifer designated for potable water use pursuant to Rule 62-520.410, F.A.C.

2. The Authority withdraws water from the Peace River to produce potable water at its on-site water treatment plant. When this potable water is injected and stored within the Suwannee limestone formation it reacts with the native materials of the formation causing naturally occurring arsenic in the formation to go into solution. The levels of arsenic sometimes exceed the 0.010 mg/L ground water quality standard, but such exceedances are limited in areal extent to a radius of a few hundred feet around the ASR wells. The Authority's petition requests an exemption from the ground water standard for arsenic contained in Rule 62-520.420(1), F.A.C., which is the same as the drinking water standard for arsenic in Rule 62-550.310, F.A.C., having a maximum contaminant level of 0.010 mg/L. The petition requests that the ASR system be operated such that the arsenic concentration does not exceed 0.010 mg/L at the property boundary of land owned by the Authority or at the boundary of easements granted to the Authority by the Southwest Florida Water Management District (SWFWMD).

3. The Department has permitting jurisdiction for the ASR wellfields under Chapter 403 of the Florida Statutes. The project is not exempt from these permitting procedures. The Department has determined a UIC permit is required for operation of the ASR wellfields.

4. The Authority is currently authorized to inject potable water, which has received full treatment from the on-site treatment plant to ground water under UIC Operation Permit Number 0136595 -005-UO (Wellfield 1) and UIC Construction Permit Number 0136595 -010-UC (Wellfield 2). These permits expire on August 3, 2013, and December 10, 2016, respectively. The Authority has applied for a single UIC operation permit to cover injection and recovery operations at both wellfields, and if issued, will supersede the two permits listed above. The ground water quality criteria exemption, if granted, will be incorporated into the UIC operation permit and will be valid for the duration of said permit. Future exemptions must be petitioned for by the applicant in conjunction with a renewal of the operation permit or other UIC permits that may be issued for any other injection wells at the facility. The exemption extends only to ground water elements of the Authority's UIC permit. The exemption will not affect the Authority's required compliance with Rules 62-550, 62-555, and 62-560, F.A.C., related to operation of its public drinking water system.

5. The Department has reviewed the above petition for an exemption under the requirements of Rule 62-520.500, F.A.C., and intends to grant the exemption to the Authority based on the following findings:

(a) Rule 62-520.500(1), F.A.C.: Granting the exemption is clearly in the public interest.

The Authority provides the majority of drinking water to persons residing within its service area in Charlotte, Sarasota, and Desoto counties, as well as the City of North Port, totaling over 250,000 persons. Use of the ASR wellfields reduces demand on the fresh water resources in these areas. The Authority is obligated to provide up to 32.7 million gallons per day of drinking water to its service area. Storing excess water through the use of ASR wells allows the Authority to augment its potable water supplies without increasing the use of the limited supply provided by the Peace River. Granting the ground water quality criteria exemption for the Authority's ASR system will assist the Authority in meeting the demand for a reliable supply of drinking water at a reasonable cost, while not adversely affecting the environment.

(b) Rule 62-520.500(2), F.A.C.: Compliance with such criteria is unnecessary for the protection of present and future potable water supplies.

The injected potable water meets all ground and drinking water standards, including arsenic. Arsenic is a naturally occurring element in the minerals of the Suwannee Limestone. Injected potable water is high in dissolved oxygen, unlike the native ground water in the aquifer which is low in dissolved oxygen. Complex oxidation and reduction reactions between the high and low dissolved oxygen waters cause arsenic contained in the aquifer minerals to go into solution. Arsenic levels that exceed the 0.010 mg/L ground water and drinking water standard are often found in the water that is recovered from the ASR wells and occasionally in Suwannee Limestone monitoring wells. All water that is recovered from the ASR wells is returned to on-site reservoirs, which hold Peace River surface water. These reservoirs have a combined capacity of over six billion gallons and therefore any elevated arsenic concentrations in

the recovered water are reduced through blending with Peace River water contained in the reservoirs. Waters within the reservoirs are sent to the Authority's drinking water plant for treatment. After treatment the potable water meets all drinking water standards and is distributed to the Authority's customers. Levels of arsenic in water from the Authority's distribution system have always been less than the drinking water standard.

Wellfield 1 has been in operation for over 25 years, and Wellfield 2 has been in operation for over 10 years. Monitoring conducted since the wellfields have been in operation show the area within the Suwannee Limestone formation, which contains elevated arsenic concentration is limited to a few hundred feet around each ASR well. Monitoring wells located within the Suwannee Limestone at the property boundaries have never had levels of arsenic above 0.010 mg/L, demonstrating that elevated levels of arsenic remain within the Authority's property boundaries.

The SWFWMD granted the Authority two easements over SWFWMD-owned land to allow for water resource development. No other entity may construct a well or use any water resource within these easements areas. The easements add an additional property buffer to the Authority-owned land, providing further assurance that any arsenic mobilized will not impact other users of ground water in the area.

Based on water samples obtained during ASR well construction and testing, the Suwannee Limestone formation has a natural total dissolved solids (TDS) concentration of approximately 800 mg/L, which exceeds the secondary drinking water standard for TDS of 500 mg/L. Because of the depth to the injection zone and the natural TDS concentrations, domestic potable wells in the vicinity of the ASR wellfields do not use the Suwannee Limestone formation water for drinking water supply. The injected fluid

will have a lower TDS concentration than the ground water in the injection zone. This fluid meets all of the primary drinking water standards as well as all secondary drinking water standards. Injection does not adversely affect the receiving ground water or the environment because the stored fluid meets all of the federal primary and state secondary drinking water standards with the exception of elevated arsenic concentrations limited in areal extent and primarily occurring during ASR well recovery, when the stored water volume is decreasing.

(g) Rule 62-520.500(3), F.A.C.: Granting the exemption will not interfere with existing uses or the designated use of the waters or of contiguous water.

A well and water use inventory of public records provided as part of the UIC operation permit application demonstrated limited ground water use in the Suwannee Limestone portion of the Floridan aquifer within one mile of the ASR site. The inventory verified there are ten water use permits utilizing Suwannee Limestone ground water within one mile of the ASR site. They are all irrigation, mining, and agricultural wells; none are used for drinking water. There were no water use permits that identified use of the Surficial aquifer.

The only confirmed public supply and domestic water use within a one-mile radius from the ASR facility are 33 wells permitted in the overlying intermediate aquifer system. The deepest of these wells is 340 feet deep, with the intermediate aquifer supply intervals separated from the Suwannee Limestone by over 150 feet of a confining unit consisting of low permeability rocks. All the monitoring wells located in the intermediate aquifer have arsenic concentrations less than 0.010 mg/L. The proposed exemption for arsenic on the property owned by the Authority or controlled by

the easements will not impact the Intermediate aquifer water use near the Injection well site. ASR operations conducted at the site for over 25 years have not interfered with ground water use in the area.

(d) Rule 62-520.500(4), F.A.C.: The economic, environmental, and social costs of compliance with the criteria outweigh the economic, environmental, and social benefits of compliance.

The economic, environmental, and social costs of preventing the release of arsenic within the Suwannee Limestone formation during ASR operations from exceeding the ground water and primary drinking water standard for arsenic outweigh the economic, environmental, and social benefits of preventing such release. Preliminary studies indicate use of a deoxygenation system could reduce dissolved oxygen levels in the injected water to a level where arsenic mobilization in the aquifer would likely not occur. An estimated twenty-six million dollars would be required for construction in addition to one million dollars of annual operation and maintenance costs for a system sized for the capacity of Authority's ASR wellfields. The feasibility of such a system for up to twenty-one million gallons of water per day is unknown because the few such systems tested have been operated at facilities with ASR wellfield capacities of about one million gallons per day. Also, these systems have short operational histories and not all have been successful in reducing arsenic mobilization. Use of the deoxygenation system by the Authority would result in significant costs with little derived benefit. As the ASR wells are currently operated the recovered water is blended with water in the reservoirs and subsequently treated at the Authority's drinking water plant to meet all primary and secondary drinking water standards prior to

distribution to its customers. Granting the water quality criteria exemption for arsenic therefore outweighs the environmental benefit of compliance as there are adequate safeguards to protect the environment and public health.

Background water quality of the Suwannee Limestone formation into which injection occurs exceeds the drinking water standard for TDS, and because of this it is not currently used as a source of drinking water. Granting the exemption from the arsenic standard within a limited portion of the Floridan aquifer within property owned or controlled by the Authority will not adversely impact the very limited use of ground water from this portion of the aquifer or the use of the overlying Intermediate aquifer system.

Social and environmental benefits are realized by storing surface water withdrawals underground during high river flow periods and recovery of the stored water for use during drier periods when river withdrawal is restricted or prohibited. Storing the water underground reduces the need to construct costly above ground reservoirs, which can impact wetlands, or to develop alternative water supplies such as reverse osmosis treatment facilities, that are not only costly, but require large amounts of electric power. During the drought of 2006-2009 the ASR Wellfield provided the majority of water supplied to the Authority's service area, thereby averting a water shortage.

(e) Rule 62-620.600(5), F.A.C.: An adequate monitoring program approved by the Department has been established to ascertain the location and approximate dimensions of the discharge plume, to detect any leakage of contaminants to other aquifers or surface waters, and to detect any adverse effect of underground geologic formations or waters.

Ground water quality and water level data are collected from twenty-four monitoring wells. Sixteen wells are within the Suwannee Limestone of the Floridan aquifer and eight are within the overlying intermediate aquifer system. Nine monitoring wells are located in Wellfield 1 and fifteen wells are in Wellfield 2. Thus, both the ASR zone and the overlying intermediate aquifer system are monitored to detect any adverse effects related to ASR activities at the site. In addition to arsenic, over 20 other parameters are analyzed and reported for the monitoring wells. The quality of the injected potable water and the water recovered from ASR wells is also monitored regularly to ensure compliance with the ground water standards and other monitoring requirements contained in the UIC permits. The monitoring program will be continued under the new UIC permit for operation of both the ASR wellfields.

This proposed exemption requires that monitoring wells continue to demonstrate that ground water with more than 0.010 mg/L of arsenic is not migrating in the ASR zone beyond land owned by the Authority or the easements granted by the SWFWMD.

(f) Rule 62-520.500(6), F.A.C.: The requested exemption will not present a danger to the public health, safety, or welfare.

The requested water quality criteria exemption for arsenic is not expected to present a danger to the public health, safety, or welfare if limited in extent to the ASR zone on property controlled by the Authority. Information provided in the petition indicates excess levels of arsenic in ground water will not migrate to the overlying Surficial aquifer or intermediate aquifer systems, or migrate beyond the property owned or controlled by the Authority within the Suwannee Limestone formation of the Floridan

aquifer. The proposed exemption is for property owned or controlled by the Authority and at a sufficient depth to ensure that public access to the potentially affected ground water will not occur. The Authority's public water system will continue to meet all federal and state drinking water standards.

6. The Department intends to grant this exemption subject to the following conditions:

(a) The exemption is granted for the duration of the Authority's Class V well Operation Permit Number 0136595-014-UO for Wellfields 1 and 2. Future exemptions must be petitioned for by the applicant in conjunction with a renewal of the operation permit or another UIC permit for any other injection wells at the facility.

(b) The exemption provides relief only for the ground water arsenic standard of Rule 62-520.420, F.A.C., which adopts by reference the drinking water standards contained in Rule 62-550.310, F.A.C. Compliance with all other ground water quality standards, including the other primary drinking water standards contained in Rule 62-550.310, F.A.C., the secondary standards contained in Rule 62-550.320, F.A.C., and the minimum criteria contained in Rule 62-520.400, F.A.C., are not affected by this exemption.

(c) The permittee shall monitor water quality in accordance with the specific conditions of the Operation Permit Number 0136595-014-UO with the additional requirements:

1. **Monitoring Wells** – If the maximum contaminant level (MCL) for arsenic (0.010 mg/L) is exceeded at Suwannee Limestone monitoring wells M-2, M-15, M-18, M-19, or M-21, or at Intermediate aquifer system monitoring wells E, I-7, I-8, I-10, T-2,

T-7, T-8, or T-11, a confirmation sample shall be obtained and analyzed within three business days after receipt of the first sample result. If the arsenic concentration confirmation sample is greater than the MCL, the Authority shall investigate the MCL exceedance(s) and within 90 days provide to the Department a report that evaluates the potential causes of the exceedances and actions proposed by the Authority to abate or eliminate the exceedances. Potential actions shall include but not be limited to the cessation of injection into nearby ASR wells until the affected monitoring wells come into compliance.

2. **Injected Fluid** – All injected fluid shall receive full treatment at the Authority's water treatment plant and shall meet all primary drinking water standards contained in Rule 62-550.310, F.A.C., the secondary standards contained in Rule 62-550.320, F.A.C., and the minimum criteria contained in Rule 62-520.400, F.A.C.

(d) The permittee shall use the data obtained during operation under the term of Permit Number 0136595-014-UO and this exemption to reassess the adequacy of the monitoring program. The results of this reassessment shall be submitted with the application for renewal of the UIC permit and this exemption.

Pursuant to section 403.815, F.S., and Rule 62-110.106(7), F.A.C., you (the applicant) are required to publish at your own expense the enclosed Notice of Intent to Grant a Water Quality Exemption. The notice shall be published one time only within 30 days from the date of issuance of this notice of intent in the legal ad section of a newspaper of general circulation in the area affected. For the purpose of this rule, "publication in a newspaper of general circulation in the area affected" means publication in a newspaper meeting the requirements of sections 50.011 and 50.031,

F.S., in the county where the activity is to take place. The applicant shall provide an original copy of the proof of publication to Mr. Joseph Haberfeld, P.G., Florida Department of Environmental Protection, Aquifer Protection Program, 2600 Blair Stone Road, Mail Station 3530, Tallahassee, Florida 32399-2400, within seven days of publication. Failure to publish the notice and provide proof of publication within the allotted time may result in denial of the exemption.

The Department will issue the exemption with the attached conditions unless a timely petition for an administrative hearing is filed under sections 120.569 and 120.57, F.S. The procedures for petitioning for a hearing are set forth below.

A person whose substantial interests are affected by the Department's proposed exemption decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57, F.S. The petition must contain the information set forth below and must be filed (received) with the Agency Clerk in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000. Petitions filed by the exemption applicant or any of the parties listed below must be filed within 21 days of receipt of this written notice.

Petitions filed by any other persons other than those entitled to written notice under section 120.60(3), F.S., must be filed within 21 days of publication of the public notice or receipt of the written notice, whichever occurs first. Under section 120.60(3), F.S., however, any person who asked the Department for notice of agency action may file a petition within 21 days of receipt of such notice, regardless of the date of publication. The petitioner shall mail a copy of the petition to the applicant at the address indicated above at the time of filing. The failure of any person to file a petition

within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will only be at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C.

A petition that disputes the material facts on which the Department's action is based must contain the following information, as required by Rule 28-106.201, F.A.C.

(a) The name and address of each agency affected and each agency's file or identification number, if known;

(b) The name, address, and telephone number of the petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding and an explanation of how the petitioner's substantial interests will be affected by the agency determination;

(c) A statement of when and how the petitioner received notice of the agency decision;

(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;

(e) A concise statement of the ultimate facts alleged, including specific facts the petitioner contends warrant reversal or modification of the Department action;

(f) A statement of the specific rules and statutes the petitioner contends requires reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and

(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take with respect to the agency's proposed action.

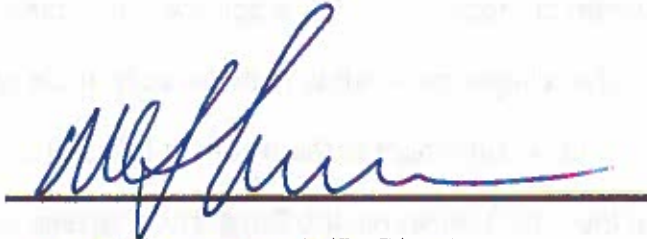
A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise contain the same information as set forth above, as required by Rule 28-106.301, F.A.C.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department on the petition have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation under section 120.573, F.S., is not available for this proceeding.

A party to this order has the right to seek judicial review of it under section 120.68, F.S., by filing a notice of appeal under Rule 9.110 of the Florida Rules of Appellate Procedure with the Agency Clerk of the Department in the Office of General Counsel, Mail Station 35, 3900 Commonwealth Boulevard, Tallahassee, Florida, 32399-3000, and by filing a copy of the notice of appeal accompanied by the applicable filing fees with the appropriate district court of appeal. The notice must be filed within thirty days after this order is filed with the clerk of the Department.

DONE AND ENTERED this 12 day of December 2012 in Tallahassee, Florida.

A handwritten signature in blue ink, appearing to read 'Mark P. Thomasson', is written over a horizontal line.

Mark P. Thomasson, P.E., Director
Division of Water Resource Management
State of Florida Department of
Environmental Protection
2600 Blair Stone Road
Tallahassee, Florida 32399-2400

Copies furnished to:

Patrick J. Lehman, P.E., Peace River Manasota Regional Water Supply Authority
Mike Coates, P.G., Peace River Manasota Regional Water Supply Authority
Mark McNeal, P.G., ASR-US, LLC
Craig Varn, Manson Law Group
Mauryn McDonald, DEP/Tampa
Bill Kelsey, DEP/Tampa
Rommy Lahera-Aument, DEP/Tampa
Amanda Bush
Greg DeAngelo
James Alexander
Blake Gullory, Southwest Florida WMD
Ann Shortelle, Suwannee River WMD

Enclosure: Public Notice

STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
NOTICE OF INTENT TO GRANT A WATER QUALITY CRITERIA EXEMPTION

The Department of Environmental Protection gives notice of its intent to grant an exemption from the Class G-II ground water standard for arsenic pursuant to Rule 62-520.500, Florida Administrative Code (F.A.C.), as part of the operations of the Peace River Manasota Regional Water Supply Authority ("Authority") Aquifer Storage and Recovery (ASR) Well System Wellfield 1 and Wellfield 2 located at 8998 SW County Road 769 in DeSoto County, Florida. The wellfields inject potable water, which has received full treatment from the on-site water treatment plant, into Class G-II ground water for storage and subsequent recovery during dry periods. Injected water will meet all drinking water standards including arsenic. The exemption is necessary because arsenic above the ground water standard has been detected in recovered ground water from Authority-owned ASR wells. Ground water monitoring demonstrates that this is not occurring outside the boundaries of property owned or controlled by the Authority. All recovered water is blended or treated to ensure all drinking water standards are met prior to distribution. The exemption is granted for the duration of the Authority's Underground Injection Control Operation Permit Number 0136595-014-UO. The applicant must petition for any future exemptions.

A person whose substantial interests are affected by the Department's proposed exemption decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes (F.S.). The petition must contain the information set forth below and must be filed (received) with the Agency Clerk in the

Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, within 21 days of publication of this notice. The petitioner must also mail a copy of the petition to the applicant, Mr. Patrick J. Lehman, P. E., Peace River Manasota Regional Water Supply Authority, 9415 Town Center Parkway, Lakewood Ranch, Florida 34202, at the time of filing.

The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will only be at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.205, F.A.C.

A petition that disputes the material facts on which the Department's action is based must contain the following information, as required by Rule 28-106.201, F.A.C.

(a) The name and address of each agency affected and each agency's file or identification number, if known;

(b) The name, address, and telephone number of the petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding and an explanation of how the petitioner's substantial interests will be affected by the agency determination;

(c) A statement of when and how the petitioner received notice of the agency decision;

(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;

(e) A concise statement of the ultimate facts alleged, including specific facts the petitioner contends warrant reversal or modification of the Department action;

(f) A statement of the specific rules and statutes the petitioner contends requires reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and

(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take with respect to the agency's proposed action.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise contain the same information as set forth above, as required by Rule 28-106.301, F.A.C.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department on the petition have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation is not available for this proceeding.

The application is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at the Florida Department of Environmental Protection, 2600 Blair Stone Road, Tallahassee, Florida

32399-2400 (contact Joseph Haberfeld, P.G., at 850-245-8655), or at the Department of Environmental Protection, Southwest District Office, 13051 North Telecom Parkway, Temple Terrace, Florida 33637-0928 (contact Rommy Lahera-Aument, P.G., at 813-632-7600).

EXHIBIT II

Peace River Manasota
Regional Water Supply Authority

JAN 15 2013

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PUBLISHER'S AFFIDAVIT OF PUBLICATION

STATE OF FLORIDA

COUNTY OF CHARLOTTE:

Before the undersigned authority personally appeared Diane Brinckman, who on oath says that she is legal clerk of the Charlotte Sun and Englewood Sun, a newspaper published at Charlotte Harbor in Charlotte County, Florida; that the attached copy of advertisement, being a Notice of Exemption, was published in said newspaper in the issues of:

January 9, 2013

Affiant further says that the said newspaper is a newspaper published at Charlotte Harbor, in said Charlotte County, Florida, and that the said newspaper has heretofore been continuously published in said Charlotte County, Florida, Sarasota County, Florida and DeSoto County, Florida, each day and has been entered as periodicals matter at the post office in Punta Gorda, in said Charlotte County, Florida, for a period of 1 year next preceding the first publication of the attached copy of advertisement; and affiant further says that he or she has neither paid nor promised any person, firm or corporation any discount, rebate, commission or refund for the purpose of securing this advertisement for publication in the said newspaper.

Diane Brinckman
(Signature of Affiant)

Sworn and subscribed before me this 9th day of January, 2013.

Amber Freeman
(Signature of Notary Public)

Amber Freeman
(Print Name)

Personally known OR Produced Identification

Type of Identification Produced _____



STATE OF FLORIDA
DEPARTMENT OF ENVIRONMENTAL PROTECTION
NOTICE OF INTENT TO GRANT A
WATER QUALITY CRITERIA
EXEMPTION

The Department of Environmental Protection gives notice of its intent to grant an exemption from the Class G-I ground water standard for arsenic pursuant to Rule 62-820.800, Florida Administrative Code (F.A.C.), as part of the operations of the Peace River Manasota Regional Water Supply Authority ("Authority") Aquifer Storage and Recovery (ASR) Well System Wellfield 1 and Wellfield 2 located at 8998 SW County Road 769 in DeSoto County, Florida. The wellfields inject potable water, which has received full treatment from the on-site water treatment plant, into Class G-I ground water for storage and subsequent recovery during dry periods. Injected water will meet all drinking water standards including arsenic. The exemption is necessary because arsenic above the ground water standard has been detected in recovered ground water from Authority-owned ASR wells. Ground water monitoring demonstrates that this is not occurring outside the boundaries of property owned or controlled by the Authority. All recovered water is blended or treated to ensure all drinking water standards are met prior to distribution. The exemption is granted for the duration of the Authority's Underground Injection Control Operation Permit Number 0136595-014-UO. The applicant must petition for any future exemptions.

A person whose substantial interests are affected by the Department's proposed exemption decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes (F.S.). The petition must contain the information set forth below and must be filed (received) with the Agency Clerk in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, within 21 days of publication of this notice. The petitioner must also mail a copy of the petition to the applicant, Mr. Patrick J. Lehman, P.E., Peace River Manasota Regional Water Supply Authority, 9415 Town Center Parkway, Lakewood Ranch, Florida 34202, at the time of filing.

The failure of any person to file a petition within the appropriate time period shall constitute a waiver of that person's right to request an administrative determination (hearing) under sections 120.569 and 120.57, F.S., or to intervene in this proceeding and participate as a party to it. Any subsequent intervention (in a proceeding initiated by another party) will only be at the discretion of the presiding officer upon the filing of a motion in compliance with Rule 28-106.20a, F.A.C.

A petition that disputes the material facts on which the Department's action is based must contain the following information:

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JAN 21 2013

UIC PROGRAM

mation, as required by Rule 28-106.301, F.A.C.

(a) The name and address of each agency affected and each agency's file or identification number, if known;

(b) The name, address, and telephone number of the petitioner; the name, address, and telephone number of the petitioner's representative, if any, which shall be the address for service purposes during the course of the proceeding and an explanation of how the petitioner's substantial interests will be affected by the agency determination;

(c) A statement of when and how the petitioner received notice of the agency decision;

(d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;

(e) A concise statement of the ultimate facts alleged, including specific facts the petitioner contends warrant reversal or modification of the Department action;

(f) A statement of the specific rules and statutes the petitioner contends require reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and

(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take with respect to the agency's proposed action.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise contain the same information as set forth above, as required by Rule 28-106.301, F.A.C.

Because the administrative/hearing process is designed to formulate final agency action, the filing of a petition means that the Department final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department on the petition have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

Mediation is not available for this proceeding.

The application is available for public inspection during normal business hours, 8:00 a.m. to 5:00 p.m., Monday through Friday, except legal holidays, at the Florida Department of Environmental Protection, 2600 Blair Stone Road, Tallahassee, Florida 32399-2400 (contact Joseph Haberfeld, P.G., at 850-245-8655), or at the Department of Environmental Protection, Southwest District office, 13051 North Telecom Parkway, Temple Terrace, Florida 33637-0926 (contact Rommy Lahera-Aument, P.G., at 813-632-7600).

Publish: January 9, 2013

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EXHIBIT II

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EXHIBIT III

Miscellaneous
Published December 14, 2012

DEPARTMENT OF ENVIRONMENTAL PROTECTION

Division of Water Resource Management

NOTICE OF INTENT TO GRANT A WATER QUALITY CRITERIA EXEMPTION

The Department of Environmental Protection gives notice of its intent to grant an exemption from the Class G-II ground water standard for arsenic pursuant to Rule 62-320.500, Florida Administrative Code (F.A.C.), as part of the operations of the Peace River Manasota Regional Water Supply Authority ("Authority") Aquifer Storage and Recovery (ASR) Well System Wellfield 1 and Wellfield 2 located at 8998 SW County Road 769 in DeSoto County, Florida. The wellfields inject potable water, which has received full treatment from the on-site water treatment plant, into Class G-II ground water for storage and subsequent recovery during dry periods. Injected water will meet all drinking water standards including arsenic. The exemption is necessary because arsenic above the ground water standard has been detected in recovered ground water from Authority-owned ASR wells. Ground water monitoring demonstrates that this is not occurring outside the boundaries of property owned or controlled by the Authority. All recovered water is blended or treated to ensure all drinking water standards are met prior to distribution. The exemption is granted for the duration of the Authority's Underground Injection Control Operation Permit Number 0136595-014-UO. The applicant must petition for any future exemptions.

A person whose substantial interests are affected by the Department's proposed exemption decision may petition for an administrative proceeding (hearing) under sections 120.569 and 120.57 of the Florida Statutes (F.S.). The petition must contain the information set forth below and must be filed (received) with the Agency Clerk in the Office of General Counsel of the Department at 3900 Commonwealth Boulevard, Mail Station 35, Tallahassee, Florida 32399-3000, within 21 days of publication of this notice. The petitioner must also mail a copy of the petition to the applicant, Mr. Patrick J. Lehman, P. E., Peace River Manasota Regional Water Supply Authority, 9415 Town Center Parkway, Lakewood Ranch, Florida 34202, at the time of filing.

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A petition that disputes the material facts on which the Department's action is based must contain the following information, as required by Rule 28-106.201, F.A.C.

- (a) The name and address of each agency affected and each agency's file or identification number, if known;
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- (d) A statement of all disputed issues of material fact. If there are none, the petition must so indicate;
- (e) A concise statement of the ultimate facts alleged, including specific facts the petitioner contends warrant reversal or modification of the Department action;
- (f) A statement of the specific rules and statutes the petitioner contends requires reversal or modification of the agency's proposed action, including an explanation of how the alleged facts relate to the specific rules or statutes; and

EXHIBIT III

(g) A statement of the relief sought by the petitioner, stating precisely the action that the petitioner wants the Department to take with respect to the agency's proposed action.

A petition that does not dispute the material facts on which the Department's action is based shall state that no such facts are in dispute and otherwise contain the same information as set forth above, as required by Rule 28-106.301, F.A.C.

Because the administrative hearing process is designed to formulate final agency action, the filing of a petition means that the Department final action may be different from the position taken by it in this notice. Persons whose substantial interests will be affected by any such final decision of the Department on the petition have the right to petition to become a party to the proceeding, in accordance with the requirements set forth above.

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McManus, Fred

From: Haberfeld, Joe [Joe.Haberfeld@dep.state.fl.us]
Sent: Thursday, July 25, 2013 2:28 PM
To: McManus, Fred
Subject: RE: question- class 1 wells

Just one clarification on what I wrote Tuesday. The Vero Beach well is in Indian River County; so there are 6 facilities and 7 wells in Brevard Co., and 1 facility/1 well in Indian River Co.

From: McManus, Fred [mailto:Mcmanus.Fred@epa.gov]
Sent: Tuesday, July 23, 2013 4:00 PM
To: Haberfeld, Joe
Cc: Marsh, Nancy
Subject: RE: question- class 1 wells

Thanks Joel! You are The Man! Based on the empirical data, it seems a huge stretch to associate the algal blooms/seagrass die-off in the IRL to nutrients associated with Class I municipal injection wells.

Fred

From: Haberfeld, Joe [mailto:Joe.Haberfeld@dep.state.fl.us]
Sent: Tuesday, July 23, 2013 3:15 PM
To: McManus, Fred
Subject: RE: question- class 1 wells

Fred,

In Brevard County, there are 7 permitted Class I municipal injection facilities which contain a total of 8 injection wells. All facilities have monitoring wells in USDW aquifers, which are shallower than the injection interval. None of the monitoring wells within the USDW have shown evidence of municipal effluent. The USDW monitoring wells are used to sample the groundwater monthly (weekly in the case of Vero Beach) and are generally completed between the depths of 300 to 1300 feet.

One discontinued Class I well, the City of Melbourne D.B. Lee well, did cause fluid movement into the lower USDW at approximately 1200 feet deep, but shallower wells did not show this effect. Injection has not occurred there since 1988 and the well was plugged abandoned within the last five years.

Joseph Haberfeld
Professional Geologist
Underground Injection Control Program Coordinator
Aquifer Protection Program
Florida Department of Environmental Protection
2600 Blair Stone Road
Mail Station 3530
Tallahassee, Florida 32399-2400
Phone 850-245-8655
joe.haberfeld@dep.state.fl.us

Please take a few minutes to share your comments on the service you received from the department by clicking on this link. [DEP Customer Survey](#)

From: McManus, Fred [<mailto:Mcmanus.Fred@epa.gov>]

Sent: Tuesday, July 23, 2013 12:05 PM

To: Haberfeld, Joe

Cc: Marsh, Nancy

Subject: FW: question- class 1 wells

Joe, see email below from Susie in Senator Nelson's office and the associated article, especially, the highlighted portion. I think the source of nutrients to IRL is more likely the hundreds of thousands of septic systems and not the Class I municipal wells; seems to me that any fluid movement from the injection zone would first have to migrate through all the semi-confining zones and the USDWs before it reaches surface waters and this could take years (i.e., tens to hundreds). I think that fertilizer in surface runoff (i.e., stormwater) also contributes to the nutrient loading in the IRL. I also plan to contact the lead scientist with the IRL NEP to get the NEP's thoughts on this article and Drew Kendall, the Region 4 IRL NEP coordinator.

What do you think?

Thanks,

Fred

From: Wise, Allison

Sent: Tuesday, July 23, 2013 10:59 AM

To: McManus, Fred

Cc: Mundrick, Doug; Allenbach, Becky; Giattina, James; Mitchell, Gail

Subject: RE: question- class 1 wells

All: Susie in Senator Nelson's office would like to talk to us regarding algal blooms in the IRL. She wants to discuss the possible link (if any) between deep well injection and problems occurring in the lagoon.

I would like to set up a call later this week.

Toxins on Indian River Lagoon seaweed might be killing manatees, but mystery remains

CRAIG PITTMANTampa Bay Times

Wednesday, July 17, 2013 12:10pm

A government research chemist has isolated what he calls "a suite of toxins" on seaweed eaten by the 112 manatees that have died in Florida's Indian River Lagoon.

Some of the toxins may be previously unidentified by science, and flourished because of sewage-fueled algae blooms that killed sea grass.

"These animals are swimming in some highly toxic water," said Peter Moeller, a chemist with the National Ocean Service. However, scientists say that doesn't explain why 52 dolphins and about 300 pelicans died there, since they ate fish, not seaweed.

The manatees filled their bellies with the reddish seaweed called Gracilaria because their normal food, sea grass, had been wiped out by a series of huge algae blooms fueled by nutrient pollution in the lagoon.

Initially, scientists thought fertilizer was the source of the pollution, but tests by Brian Lapointe from Harbor Branch Oceanographic Institute have found that the culprit is actually sewage. The sewage could be coming from leaks in the estimated 300,000 septic tanks scattered around the lagoon on the state's Atlantic coast, he said, or it could be migrating into the lagoon from the deep-well injection of treated sewage into the aquifer.

Vero Beach switched to deep-well injection two years ago after the state Department of Environmental Protection said the city had to stop dumping treated sewage directly into the lagoon. The DEP subsequently approved the \$11 million deep-well injection system. Last year, one DEP official called it "one of the best deep wells I have ever seen."

Whether the sewage source is the wells or the septic tanks or some combination of the two, Lapointe said, "Basically the Indian River Lagoon is being used as part of our sewage treatment system."

The Indian River Lagoon has long been hailed as the most diverse ecosystem in North America. Its 156 miles of waterways boast more than 600 species of fish and more than 300 kinds of birds, attracting anglers and tourists to the towns along its shore, such as Titusville, Cocoa, Melbourne, Vero Beach and Stuart.

But a series of algae blooms wiped out more than 47,000 acres of its sea grass beds, which one scientist compared to losing an entire rainforest in one fell swoop. Then, beginning last summer, manatees began dying, and they haven't stopped. Soon dolphins and pelicans began dying, too.

The pelican die-off apparently stopped in mid April, according to Kevin Baxter of the Florida Fish and Wildlife Conservation Commission, but the manatee and dolphin die-off is continuing. The most recent dead manatee turned up July 9, he said.

When Lapointe and an assistant, Laura Herren, collected Gracilaria from the lagoon for Moeller to examine, they noticed it was covered in fuzz. "Those are the microscopic algae that we think are producing the toxins," Lapointe said.

Moeller said he was able to extract what he called "novel toxins that had not been described before." When he exposed cells from mammals to the toxins, the toxins killed the cells, he said.

While that strongly suggests the toxins on the Gracilaria are what killed the manatees, Moeller said, "any direct link to the manatee deaths is a long way off."

Meanwhile, "we have not found a definitive cause" for the dolphin deaths, said Megan Stolen, a research scientist at the Hubbs-SeaWorld Research Institute. "We have been careful not to lump the manatee deaths with the dolphin deaths since they eat different things, although that doesn't mean there's no direct relation."

So far only one dolphin sickened by whatever is in the lagoon has been captured alive. However, Stolen said this week, that dolphin — found by a kayaker last month and now being cared for at SeaWorld — has not yielded any clues to what's killing the others.

Craig Pittman can be reached at craig@tampabay.com

Teresa Mazza with Hubbs-SeaWorld

A kayaker found a sick dolphin in Indian River Lagoon last month. It has yielded no clues as to what's causing dolphin deaths.

Toxins on Indian River Lagoon seaweed might be killing manatees, but mystery remains 07/17/13 [Last modified: Wednesday, July 17, 2013 9:55pm]

From: McManus, Fred
Sent: Tuesday, July 23, 2013 7:47 AM
To: Wise, Allison
Cc: Mundrick, Doug; Allenbach, Becky
Subject: RE: question- class 1 wells

Here you go Allison!

Florida (specifically, south Florida) is the only state in the country where domestic wastewater (i.e., treated sewage) is disposed of via deep (from about 2,000 to 3,400 feet below the surface) injection wells into a carbonate formation known as the Boulder Zone as an alternative to surface disposal. The Boulder Zone is located below ground water aquifers that are currently used or may be used as a source of drinking water and are referred to as underground sources of drinking water (USDWs). These deep injection wells are regulated by the Florida Department of Environmental Protection (FDEP) under the State's Underground Injection Control (UIC) Program and are designated as Class I municipal wells. The federal UIC regulations do not allow the injection to cause any fluid movement into USDWs. The confining geologic layer of rocks that FDEP relied upon to prevent fluid movement from the injection interval (i.e., Boulder Zone) into USDWs was found to not prevent the injected wastewater from migrating into the lowermost USDW. Because operation of Class I wells with fluid movement into USDWs is prohibited by federal UIC regulations, these facilities would be forced to cease injection and adopt an alternative method to manage their wastewater, which would increase the environmental risks to surface waters and coastal environments. Therefore, the EPA provided a regulatory alternative to owners/operators of Class I municipal wells that caused or may cause movement of fluid into USDWs. The "Revision of the Federal Underground Injection Control Requirements for Class I Municipal Disposal Wells in Florida" offers owners/operators of these Class I municipal wells the ability to continue to operate their wells, provided they meet additional wastewater treatment requirements. These new treatment requirements are designed to provide an equivalent level of protection to USDWs as provided by the no-fluid-movement requirement of the federal UIC regulations and the Safe Drinking Water Act. This alternate approach involves rigorous control of the quality of the fluids by requiring these facilities to treat their municipal wastewater with pretreatment, secondary treatment and high-level disinfection before the fluids are injected. Under this approach, the movement of fluids into USDWs should not endanger the USDWs because the quality of the wastewater has been treated to a level that is no longer a threat to USDWs.

Hope this helps,

Fred

From: Wise, Allison
Sent: Monday, July 22, 2013 11:23 AM
To: McManus, Fred
Subject: RE: question- class 1 wells

Thanks Fred. I will forward these but could you provide a paragraph or two summary? Thanks!

From: McManus, Fred
Sent: Monday, July 22, 2013 10:40 AM
To: Mundrick, Doug
Cc: Delli-Gatti, Dionne; Wise, Allison; Allenbach, Becky
Subject: RE: question- class 1 wells

Allison:

The two attached documents/fact sheets should answer the question and provide additional background information. Please let me know if you have any questions or require additional information.

Thanks,

Fred

From: Mundrick, Doug
Sent: Monday, July 22, 2013 8:54 AM
To: McManus, Fred
Cc: Delli-Gatti, Dionne; Wise, Allison
Subject: FW: question- class 1 wells

Fred, can you answer this question?

Doug

From: Wise, Allison
Sent: Monday, July 22, 2013 8:37 AM
To: Thomas, Chris; Mundrick, Doug
Cc: Delli-Gatti, Dionne
Subject: FW: question- class 1 wells

See inquiry from Senator Nelson's office.

From: PerezQuinn, Susie (Bill Nelson) [mailto:susie_perezquinn@billnelson.senate.gov]
Sent: Thursday, July 18, 2013 2:18 PM
To: Wise, Allison
Subject: question- class 1 wells

Allison,

How are you?

Your new Administrator's nomination is on the Senate floor today!

Please see the regs in the link below regarding Class I municipal disposal wells in Florida.
What prompted these regs? Thanks,

Susie

From: Orgera, Ryan (Bill Nelson)
Sent: Thursday, July 18, 2013 2:09 PM
To: PerezQuinn, Susie (Bill Nelson)
Subject: wells in CFR

<http://www.law.cornell.edu/cfr/text/40/146.15>



ASR in Florida White Paperdep 112112 (6).docx

McClagherty, Donnie to: Fred McManus

Cc: "DeAngelo, Gregory", "Haberfeld, Joe"

11/28/2012 10:22 AM

1 attachment



ASR in Florida White Paperdep112112 (6).docx

Hi Fred,

Attached are our edits in track change. This has not been reviewed by the Division office.

Thanks, Donnie

Please take a few minutes to share your comments on the service you received from the department by clicking on this link Copy the url below to a web browser to complete the DEP survey:
<http://survey.dep.state.fl.us/?refemail=Donnie.McClagherty@dep.state.fl.us>



ASR in Florida White Paper 12 03 12

Haberfeld, Joe

to:

Fred McManus

12/17/2012 09:38 AM

Hide Details

From: "Haberfeld, Joe" <Joe.Haberfeld@dep.state.fl.us>

To: Fred McManus/R4/USEPA/US@EPA

History: This message has been replied to and forwarded.

1 Attachment



ASR in Florida White Paper 12 03 12.docx

Fred,

I made corrections to the white paper on the well numbers. Our FY2012 inventory has 159 ASR wells permitted, so the 134 total must be an older number. The other numbers were adjusted to match the presentation because we made detailed lists to come up with those numbers.

Joe

Please take a few minutes to share your comments on the service you received from the department by clicking on this link [DEP Customer Survey](#).



ASR in Florida White Paper 12 20 12

Haberfeld, Joe

to:

Fred McManus

12/20/2012 04:09 PM

Cc:

Nancy Marsh, "DeAngelo, Gregory", "McClagherty, Donnie"

Hide Details

From: "Haberfeld, Joe" <Joe.Haberfeld@dep.state.fl.us>

To: Fred McManus/R4/USEPA/US@EPA

Cc: Nancy Marsh/R4/USEPA/US@EPA, "DeAngelo, Gregory"

<Gregory.DeAngelo@dep.state.fl.us>, "McClagherty, Donnie"

<Donnie.McClagherty@dep.state.fl.us>

1 Attachment



ASR in Florida White Paper 12 20 12.docx

Fred,

We briefed Mark Thomasson and Chris Klena and made some suggestions based on their comments.

Joe Haberfeld

Please take a few minutes to share your comments on the service you received from the department by clicking on this link [DEP Customer Survey](#).

1. The first part of the document is a letter from the President of the United States to the Congress, dated January 3, 1862. It is a very important document, as it contains the President's views on the state of the Union and the progress of the war.

2. The second part of the document is a report from the Secretary of the War Department, dated January 10, 1862. It contains a detailed account of the military operations of the Army during the year 1861.

3. The third part of the document is a report from the Secretary of the Navy Department, dated January 10, 1862. It contains a detailed account of the naval operations of the Navy during the year 1861.

4. The fourth part of the document is a report from the Secretary of the Interior Department, dated January 10, 1862. It contains a detailed account of the operations of the Department during the year 1861.

5. The fifth part of the document is a report from the Secretary of the Treasury Department, dated January 10, 1862. It contains a detailed account of the operations of the Department during the year 1861.

6. The sixth part of the document is a report from the Secretary of the State Department, dated January 10, 1862. It contains a detailed account of the operations of the Department during the year 1861.

7. The seventh part of the document is a report from the Secretary of the War Department, dated January 10, 1862. It contains a detailed account of the military operations of the Army during the year 1861.

8. The eighth part of the document is a report from the Secretary of the Navy Department, dated January 10, 1862. It contains a detailed account of the naval operations of the Navy during the year 1861.

9. The ninth part of the document is a report from the Secretary of the Interior Department, dated January 10, 1862. It contains a detailed account of the operations of the Department during the year 1861.

10. The tenth part of the document is a report from the Secretary of the Treasury Department, dated January 10, 1862. It contains a detailed account of the operations of the Department during the year 1861.

11. The eleventh part of the document is a report from the Secretary of the State Department, dated January 10, 1862. It contains a detailed account of the operations of the Department during the year 1861.

12. The twelfth part of the document is a report from the Secretary of the War Department, dated January 10, 1862. It contains a detailed account of the military operations of the Army during the year 1861.

Aquifer Storage and Recovery in Florida

General Background

Aquifer storage and recovery (ASR) is the practice of storing water underground for later use. ASR wells are a subset of aquifer recharge wells used to inject non-hazardous water for later recovery, even if recovery is from a separate well. As weather variability, competing sector needs and population growth exert pressure on a finite supply of water, a growing number of communities are exploring whether ASR technology can be used to meet demand. ASR projects are used to recover water for a number of beneficial uses, including drinking water needs, agriculture/irrigation and ecological restoration. EPA's Underground Injection Control (UIC) Program addresses the potential for contamination of underground sources of drinking water (USDWs) caused by injection activities. ASR wells are regulated as Class V injection wells under the UIC Program.

Water used in ASR projects is typically of high quality and meets national primary drinking water standards prior to injection, which would seem to ensure the protection of USDWs. However, EPA has received reports that exceedances of national primary drinking water standards/maximum contaminant levels (MCLs) for arsenic and disinfection byproducts (DBPs) have occurred as a result of ASR injection. Geochemical interactions between the injected water and the geologic formation may release heavy metals, iron, manganese, and/or radionuclides. Disinfecting water to meet biological MCLs prior to injection may also have negative consequences for USDWs if DBPs form in situ. ASR projects can present a complex challenge for both operators and the UIC Program.

As the amount of high quality source water declines, municipalities, states, and others have identified ASR as a technology that can be used to store drinking water for future use, and have moved forward to use the technology to store water. In 2007, EPA analyzed available information to determine whether ASR wells were being used widely, and potential impacts to USDWs from ASR injection. EPA found the most prevalent challenges to USDWs from ASR were elevated levels of metals, radionuclides and DBPs. Since 2007, EPA has received reports that elevated levels of arsenic in USDWs as a result of ASR projects are affecting several regions of the country.

Aquifer recharge (AR) is the practice of injecting water underground for the purpose of increasing the usable supply in an aquifer, offsetting ground water withdrawals, restoring the water quality of an aquifer or mitigating the effects of saltwater intrusion. The Florida Department of Environmental Protection (FDEP) has been contacted about 5 potential aquifer recharge projects in the state.

UIC Regulatory Framework

The UIC regulations, as developed to implement the requirements to protect USDWs (Part C of the SDWA), clarify the statutory requirements in 40 CFR Section 144.12(a):

No owner or operator shall construct, operate, maintain, convert, plug, abandon, or conduct any other injection activity in a manner that allows the movement of fluid containing any contaminant into USDWs, if the presence of that contaminant may cause a violation of any primary drinking water regulation under 40 CFR Part 142 or may otherwise adversely affect the health of persons.

Importance of ASR in Florida

It is estimated that the demand for fresh/drinking water to supply public water systems will increase by about 40% (i.e., from 2.5 bgd to 3.75 bgd) by the year 2030. Current water supply planning indicates that many regions of Florida are projected to not have adequate fresh water supplies to meet future demand. To meet future demand, the State of Florida has considered developing more water supplies (e.g., reclaimed water, surface water, treatment of brackish ground water/sea water, and increased storage such as reservoirs and ASR) and conservation.

With the lack of above ground reservoirs in Florida for storage, and the growing demand for water for drinking and other uses (e.g., agriculture and ecological restoration and maintenance), ASR projects using the aquifer as a water storage area are increasingly being explored and utilized. The State of Florida considers ASR an important tool to water utilities, water management districts and the state in general to help conserve and sustain the state's water resources. The emerging importance of ASR is impacted by the following facts:

- Traditional sources of freshwater are nearly tapped out and many alternative sources require storage to be reliable
- ASR can extend the reliability of alternative sources (seasonal reliability)
- ASR in conjunction with traditional storage can greatly extend reliability (drought reliability)
- Climate change may further exacerbate unreliability for some water sources, increasing the need for storage
- Availability of suitable land for traditional storage is likely to decrease in the future
- ASR can increase beneficial use of reclaimed water and minimize discharges
- ASR can reduce saltwater intrusion because it reduces withdrawals from aquifers in coastal regions
- ASR increases the ability to meet necessary environmental flows and levels

The advantages of ASR are numerous and include the following:

- Allows storage where topography and land availability are not suitable for reservoirs

- Least expensive option for large-scale storage
- ASR can be located where it is needed
- No evaporative losses from storage
- Exceptionally small surface land footprint
- Additional storage can be added as needed and easily integrated into an existing project

ASR Activities in Florida

Arsenic is a naturally-occurring element present in some sulfide-bearing minerals (pyrite – FeS₂) found in most of the aquifers used for ASR in Florida. Under the natural, low oxygen conditions normally found in the ground water, the arsenic remains bound in the carbonate rock matrix. However, the oxygenated water injected for ASR projects, causes an oxidative reaction which releases arsenic into the ground water. The FDEP has reported that 21 out of 37 ASR facilities have collected operational data on arsenic concentrations in a monitor well or in recovered water. Of those 21, 19 facilities had one or more arsenic exceedances of 10 µg/L, with several facilities having measured at least one arsenic concentration of more than 50 µg/L. Currently, one facility occasionally exceeds an arsenic concentration of more than 50 µg/L. Some facilities have arsenic values in the 10-20 µg/L range but have been in operation for many years without further decreases in the level of arsenic. There are a total 134 ASR wells in FDEP's UIC inventory report and 93 are actively injecting and recovering water or are under construction.

All ASR wells are permitted as Class V injection wells in Florida. Sources of water for ASR include drinking water, reclaimed water, surface water and ground water. Every ASR project in Florida is required to meet the primary drinking water standard for arsenic of 10 µg/L (lowered from 50 µg/L in 2006) in the injectate. Even though the water being injected meets the arsenic standard, the quality of the recovered water at the majority of ASR facilities has frequently exceeded the new standard during well testing and operation. Currently, FDEP assumes that an exceedance of a primary drinking water standard in the recovered water or a monitoring well is a violation of the UIC rules and regulations. In no case has water with greater than 10 µg/L of arsenic been delivered by a utility to the public. Also, existing recovery data indicate that arsenic levels in the recovered water are "generally lower" for facilities that have been operating for a long time, whereas increased levels usually occur at newly operational facilities.

Cycle Testing Results

To verify that compliance with national primary drinking water standards are met, ASR facilities are required to undergo cycle testing. A cycle test is the complete process of recharging, storing, and recovering a volume of water. Multiple cycles are performed due to the seasonal demands of ASR and to satisfy FDEP permit requirements. ASR wells and monitoring wells are sampled during recharge, storage, and recovery phases, normally on a weekly basis during cycle testing. Some facilities have exceeded eight cycles because they can not currently obtain an operation permit.

Monitoring of ASR facilities has demonstrated that the oxidation zone which is likely mobilizing arsenic does not exist far from the points of injection, with the radius of elevated arsenic concentrations similarly limited in extent. Data from mature facilities indicates the radius is a few hundred feet from the ASR wells. This is the case even when the stored volume of water is much greater than the area in which arsenic is mobilized. In the case of Peace River, the calculated radius of stored water is approximately 1400 feet from the center of the ASR wellfield, while arsenic mobilization is limited to a radius of approximately 200 feet from each ASR well.

Tools for Protecting USDWs in Florida

The FDEP utilizes several tools or a combination thereof to address potential exceedances of arsenic that protect both the underground sources of drinking water and public health.

Under Program Guidance Memo WRM/GW-08-01 dated April 11, 2008, the FDEP issues administrative orders or consent orders to ASR facilities that exceed or are reasonably expected to exceed the arsenic level of 10 µg/L in recovered water or at any monitoring well. Where an exceedance is observed the facility must take steps to come back into compliance. These orders include requirement to consider institutional controls for any off-site exceedances of the arsenic MCL and may require additional monitoring and cycle testing.

Other tools used by FDEP include:

- Pretreatment prior to injection to remove dissolved oxygen (degasification process) to reduce the potential for release of arsenic
- Point of Delivery to customer by retreating or blending recovered water
- Providing a zone of discharge to the property that would allow arsenic values greater than the MCL (Property Ownership)
- Institutional Controls for off-site exceedances that prohibit the use of the ASR storage zone for potable water use
- Consistent operation using similar volumes of water injected and recovered
- Water Quality Criteria Exemptions that require demonstration of public interest protection of present and future supplies and of public health, and costs benefit analyses
- Extensive monitoring of the injectate, ground water, and recovered water
- Full recovery of the injected water to reverse arsenic mobilization

Florida believes that its process for regulating ASR facilities with increased levels of arsenic provides adequate assurance that there will be “no pathway” for human consumption of ground water that exceeds the 10 µg/L MCL for arsenic. Further, it should be noted that all public water systems that utilize ASR implement point of recovery treatment techniques (i.e., filtration, blending, etc.) to render high TDS waters potable, including reducing the level of arsenic to below the MCL.

Florida's Experience with ASR and Arsenic Mitigation Tools

Pretreatment: City of Bradenton, Seminole County-Markham, City of Sanford, City of DeLand

These are 1 million gallon per day (MGD) potable water facilities. At Bradenton, degasification achieved a reduction of dissolved oxygen and chloramines adequate to prevent the mobilization of arsenic in the two most recent cycle tests. The facility may soon qualify for an operation permit. At Seminole County-Markham, a combination of degasification and dechlorination did not prevent the mobilization of arsenic and may not ultimately be successful. Four cycle tests using degasification at Sanford resulted in decreasing arsenic in the recovered water from the ASR well although it was still slightly greater than 10 µg/L. Sanford will continue with operations under a construction permit. At DeLand, sodium hydrosulfide was the method of decreasing dissolved oxygen in the injected water. Although all recovered water met the arsenic MCL, the project is idle due to operational difficulties and the additional expense of pretreatment.

Consistent Operation: City of Tampa-Rome Ave.

This is a potable water facility with 8 ASR wells cycle testing at a rate of 1 MGD each. Similar volumes of water were recharged and recovered over a testing period spanning eleven cycles. This consistent operation of the facility resulted in a steady decrease in arsenic concentration with time, but the concentration remains slightly greater than 10 µg/L with no significant improvement over the past several cycles. The maintenance of the long-term stored volume ensures that arsenic mobilization does not occur in areas unaffected by past operations.

Point of Delivery Treatment: Peace River

Peace River is a potable facility where arsenic is greater than 10 µg/L and occasionally greater than 50 µg/L. Recovered water is blended with surface reservoir water and then sent to the water treatment plant for full treatment. This process reduces arsenic to less than 10 µg/L at all times prior to distribution.

Property Ownership: Orange County

Potable water is stored by Orange County on a county-owned property which is large enough to prevent arsenic mobilization from occurring off-site. Although cycle testing resulted in arsenic greater than 10 µg/L at the ASR well, there were sporadic exceedances at a monitoring well 100 feet from the ASR well and no exceedances at a monitoring well 500 feet from the ASR well. The 500-foot monitoring well is near the property boundary, demonstrating arsenic mobilization is not occurring off-site.

Institutional Control: Tampa-Rome Ave., Destin Water Users, City of Rockledge

These three ASR facilities are operated within local ordinance areas where the construction of wells for drinking water and the use of ASR aquifer ground water for drinking is prohibited. This provides additional assurance that other users of ground water will not have access to ASR zone water. In the case of Tampa, the City provided free connections to municipal drinking water so that individual wells would not be used for this purpose.

Full Recovery of Injected Water: Kissimmee River and City of North Port

Three cycles were performed with surface water from the Kissimmee River. At 5 MGD it is the largest active single well ASR project in Florida. Each cycle generated arsenic greater than 10 µg/L in the ASR and monitoring wells, including a monitoring well 1100 feet distant from the ASR well. However, when the full injected volume was recovered for each cycle, arsenic decreased to less than 10 µg/L in each well. The City of North Port conducted cycle testing with surface water which led to some of the highest arsenic concentrations observed in Florida (greater than 100 µg/L). Full recovery of water and sampling over a several year period verified that the arsenic had decreased to less than 10 µg/L. While full recovery of injected water is not the long-term goal of ASR operators, these facilities demonstrate that full recovery is a tool that can be used to mitigate high arsenic concentrations due to ASR operations.

Conclusion/Recommendation

Florida believes that ASR and AR are not waste disposal practices but are “beneficial uses” of water that reduce the demand on freshwater aquifers, conserving the ground water in these aquifers for future use. Florida employs many tools to address any potential exceedances of the arsenic MCL associated with ASR and AR to protect USDWs and public health. Also, Florida believes it should continue to use the tools that have been working to prevent human consumption of affected ground water.



CERP ASR Project at Kissimmee
Haberfeld, Joe to: Fred McManus

11/20/2012 11:21 AM

1 attachment



Mirecki_etal_2012_GW.pdf

Fred,

I attached a recent paper by June Mirecki of the US Army Corps of Engineers on the Kissimmee site. Page 8 has graphs of arsenic for the ASR well and 2 closest monitor wells (350 and 1100 feet from the ASR well). I mis-spoke yesterday on this site. The monitor wells decreased in peak elevations of arsenic since cycle 1, but still showed increases over 10 ug/L for cycles 2 and 3. These occur during recharge and storage; the levels decrease to < 10 ug/L with recovery. However, I did remember the ASR well correctly, as it is virtually 100% compliant in cycles 2 and 3. Table 1 shows they recovered the same or greater volume of injected water, showing the arsenic levels can be brought down with continued pumping. This is a safeguard for any project which would warrant this action.

The geochemistry of this site is probably different from the non-CERP projects. This is by far the most closely studied site from that perspective because of the quality of data and the expertise of the author.

Joe

Please take a few minutes to share your comments on the service you received from the department by clicking on this link. [DEP Customer Survey](#).

From: Mcmanus.Fred@epamail.epa.gov [mailto:Mcmanus.Fred@epamail.epa.gov]
Sent: Tuesday, November 20, 2012 10:56 AM
To: Haberfeld, Joe
Subject: CERP ASR Project at Kissimmee

Hi Joe:

Good job on the conference call yesterday! During the call, you mentioned the U.S. Army COE's CERP ASR project near Kissimmee, FL and the fact that the elevated As plume during the first cycle was

detected at the monitoring well about 1,000 feet from the injection well; however, during subsequent cycles, the elevated As plume was not detected at the monitoring well about 1,000 feet from the injection well. Are the data on the Kissimmee ASR project available online? If not, could you email the data to me?

Thanks Joe and I hope you have a safe and wonderful Thanksgiving,

Fred

"Message from "Mirecki, June E SAJ" -----
June.E.Mirecki@usace.army.mil> on Fri, 2 Nov 2012 10:06:01 -0400>

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: Control During Aquifer Storage Recovery Cycle Tests in the Floridan Aquifer" just published in Ground Water" Subject

Colleagues,

I am happy to report that our work on arsenic attenuation at the Kissimmee River ASR system has been published in Ground Water. I am not sure what issue the hard copy will appear in, so I don't have the formal citation yet. Attached is the "Early view" publication from the NGWA web site, where it appeared on 25 October 2012. Many of you have contributed to this successes at Kissimmee River ASR system through well construction, operations, and data acquisition, and for this I am thankful.

If you have any questions, just feel free to ask. Please forward this to anyone I may have missed.

June

Arsenic Control During Aquifer Storage Recovery Cycle Tests in the Floridan Aquifer

by June E. Mirecki¹, Michael W. Bennett², and Marie C. López-Baláez³

Abstract

Implementation of aquifer storage recovery (ASR) for water resource management in Florida is impeded by arsenic mobilization. Arsenic, released by pyrite oxidation during the recharge phase, sometimes results in groundwater concentrations that exceed the 10 µg/L criterion defined in the Safe Drinking Water Act. ASR was proposed as a major storage component for the Comprehensive Everglades Restoration Plan (CERP), in which excess surface water is stored during the wet season, and then distributed during the dry season for ecosystem restoration. To evaluate ASR system performance for CERP goals, three cycle tests were conducted, with extensive water-quality monitoring in the Upper Floridan Aquifer (UFA) at the Kissimmee River ASR (KRASR) pilot system. During each cycle test, redox evolution from sub-oxic to sulfate-reducing conditions occurs in the UFA storage zone, as indicated by decreasing Fe²⁺/H₂S mass ratios. Arsenic, released by pyrite oxidation during recharge, is sequestered during storage and recovery by co-precipitation with iron sulfide. Mineral saturation indices indicate that amorphous iron oxide (a sorption surface for arsenic) is stable only during oxic and sub-oxic conditions of the recharge phase, but iron sulfide (which co-precipitates arsenic) is stable during the sulfate-reducing conditions of the storage and recovery phases. Resultant arsenic concentrations in recovered water are below the 10 µg/L regulatory criterion during cycle tests 2 and 3. The arsenic sequestration process is appropriate for other ASR systems that recharge treated surface water into a sulfate-reducing aquifer.

Introduction

Aquifer storage recovery (ASR) systems are important components of water resource management plans for regions that have appropriate subsurface permeability (Bloetscher et al. 2005; Dillon et al. 2005; Pyne 2005; National Academy of Sciences 2008; Maliva and Missimer 2010). In Florida, permitted ASR systems store treated surface (potable) water (Reese 2002; Mirecki

2004; Reese and Alvarez-Zarikian 2007) or reclaimed water (Clinton 2007) in the Floridan Aquifer during the wet season, for distribution back to surface water in the dry season. ASR serves as the largest component of new storage in the Comprehensive Everglades Restoration Plan (CERP; National Academy of Sciences 2001, 2002). Regional implementation of CERP ASR could capture approximately 1.6 billion gal/d (6056 megaliters/d) of surface water currently lost to tide directly through the St. Lucie Canal and Caloosahatchee River.

Arsenic mobilization during ASR cycle testing presents a significant challenge to expanded use of potable and reclaimed water ASR in Florida. The source and mechanism of arsenic mobilization during cycle testing in carbonate aquifers are well known through controlled laboratory leaching and column experiments (Fischler and Arthur 2010; Onstott et al. 2011), mineralogical characterization of aquifer matrix (Price and Pichler 2006; Pichler et al. 2011), and modeling studies (Mirecki 2006; Jones

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Received April 2012, accepted August 2012.

Published 2012. This article is a U.S. Government work and is in the public domain in the USA.

doi: 10.1111/j.1745-6584.2012.01001.x

and Pichler 2007) at Floridan Aquifer ASR systems, and also from extensive field studies at Australian reclaimed water ASR systems (Herczeg et al. 2004; Dillon et al. 2005, 2008; Vanderzalm et al. 2010, 2011). Arsenic is released during oxidation of pyrite by dissolved oxygen as recharge water flows through permeable zones in the carbonate aquifer (Jones and Pichler 2007; Fischler and Arthur 2010). Resultant arsenic concentrations measured in groundwater during ASR cycle testing can exceed the Federal and state maximum contaminant level (10 µg/L). Once released into the aquifer, arsenic can: (1) be sequestered by sorption to iron oxyhydroxide phases that are stable under oxic or sub-oxic aquifer redox conditions (Vanderzalm et al. 2011); or (2) be transported as the dissolved complex arsenate (AsV) or arsenite (AsIII) under oxic to sub-oxic, iron-poor conditions (e.g. Höhn et al. 2006); or (3) co-precipitate as an iron sulfide phase under sulfate-reducing, iron-rich conditions. The third condition has not been documented at any ASR system, and has important implications for arsenic attenuation and also regulatory compliance during ASR cycle tests in the Floridan Aquifer.

Characterization and controls on arsenic transport and fate during ASR cycle testing have been impeded in the United States by the lack of extensive sampling. Most ASR system investigations are performed by water utilities at potable water ASR systems (Florida Department of Environmental Protection [FDEP] 2007). Water-quality datasets at utility ASR systems usually are limited to analytes required for permit compliance rather than geochemical characterization. Consequently, little is known of the magnitude and duration of arsenic mobilization, and factors that control arsenic transport and fate in the Floridan Aquifer. Without better assurance that ASR systems can perform in regulatory compliance, the future of ASR implementation is uncertain.

The overall objective of CERP ASR pilot system operations is to evaluate ASR feasibility at representative locations in south Florida. ASR feasibility is demonstrated by several factors including: (1) percent recovery of recharged surface water; (2) regulatory compliance with all state and Federal water-quality criteria; and (3) cost-effective subsurface storage. At the Kissimmee River ASR (KRASR) pilot system, three cycle tests have been completed with a groundwater monitoring program objective to evaluate water-quality changes.

Arsenic mobilization and subsequent attenuation are shown during three successive cycle tests at KRASR. In this report, the geochemical controls on arsenic transport and fate during ASR cycle testing in the Upper Floridan Aquifer (UFA) are defined. Our hypothesis is that arsenic, released by oxidation of pyrite during early portions of the recharge phase, is subsequently attenuated by co-precipitation in a stable iron sulfide phase during late recharge, storage, and recovery. The native UFA sulfate-reducing redox condition is disrupted only temporarily by dissolved oxygen introduced during recharge. Addition of dissolved (probably colloidal) iron and organic carbon in recharge (surface) water, mixing with sulfate-rich

groundwater, provides abundant electron acceptors to re-establish microbe-mediated sulfate reduction, iron sulfide precipitation, and consequently arsenic attenuation. The result is that arsenic concentrations are nearly always below 10 µg/L in all well samples collected weekly during the storage and recovery phases of successive cycles at KRASR.

Hydrogeologic Setting

At KRASR, the artesian UFA occurs within a thick sequence of interlayered marine calcareous and dolomitic limestones of Eocene and Oligocene age (Figure 1), and serves as the storage zone for ASR cycle tests. The UFA is confined by the overlying Intermediate Confining Unit, which consists of approximately 400 feet (122 m) of Hawthorn Group interlayered clays, silts, and fine sands (Scott 1988). Lower confinement of the UFA is provided by the Middle Confining Unit, which consists of 400 to 500 feet (122 to 152 m) of dolomitic limestone, dolomite, and dolostone (Reese and Richardson 2008). Hydrostratigraphic and lithostratigraphic characteristics are defined using geophysical logs, lithologic descriptions, and limited coring during construction of the ASR and monitoring wells (CH₂M Hill 2004; Golder Associates 2007; Entrix 2010).

Water is stored in the UFA at depths between -543 and -856 feet (-166 and -261 meters, m) below the National Geodetic Vertical Datum of 1929 (NGVD29). However, permeability is not uniform with depth in the storage zone. Water will flow preferentially through zones of higher permeability that develop at or near unconformable formation contacts, and to a lesser extent, bedding planes. Permeability in the UFA is interpreted from geophysical logs in boreholes for the ASR and all storage zone monitor wells (SZMWs), and aquifer performance testing during construction of the ASR well. Static and dynamic flow logs were corrected for variations in borehole diameter from caliper logs, and interpreted to quantify the percent contribution of individual zones to total flow in the borehole that became the ASR well. Geophysical flow log interpretations indicate that 80% of flow occurs at the top of the storage zone, at depths between -546 and -609 feet (-166 and -186 m) NGVD29 (Figure 1). This preferential flow zone is consistent with an unconformable contact between the Arcadia Formation (lower part of the Hawthorn Group) sediments and the Ocala Limestone, and has been observed at a similar depth in all KRASR SZMWs, and commonly in UFA boreholes surrounding Lake Okeechobee (Reese and Richardson 2008). A smaller component of flow (12%) occurs below the base of the storage zone between -880 and -930 feet NGVD29. This preferential flow zone may occur near the formation contact between the Ocala Limestone and Avon Park Formation. An aquifer performance test of the entire storage interval at the ASR borehole resulted in a transmissivity value of 36,765 ft²/d (CH₂M Hill 2004).

A chloride-based conservative mixing model confirms extensive transport of recharge water along this

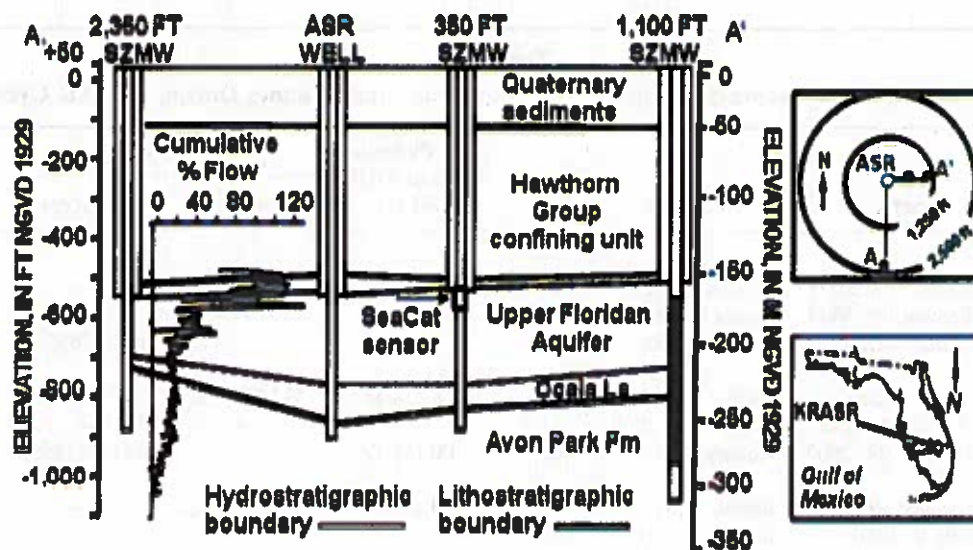


Figure 1. Hydrogeologic cross-section and plan view of the Kissimmee River ASR system. SZMW, storage zone monitor well; T, transmissivity. The 1100 feet SZMW is a dual zone well, but only upper zone sample data are presented. Horizontal axis in cross-section is not to scale. All distances are relative to the ASR well. Length conversions are: 350 feet (107 m); 1100 feet (335 m); 2350 feet (716 m); 4200 feet (1280 m).

upper preferential flow zone to the 1100 feet SZMW (Figure 2). Mixing fractions were calculated following the method of Herczeg et al. (2004) to show how the percentage of recharge water component changes throughout cycles 2 and 3 (Table S1, Supporting Information). After 1 or 2 months of recharge during cycles 2 and 3 (respectively), samples from the 1100 feet (335 m) SZMW consist of 90% or greater recharge water. This monitor well has a short open-interval (−544 to −583 feet; 166 to 178 m NGVD29) that intersects the preferential flow zone of the UFA. Interpretations of geophysical flow logs and the conservative mixing model support a conceptual hydrogeologic model in which most of the groundwater flow occurs in the a preferential flow zone of the uppermost UFA across the ASR wellfield.

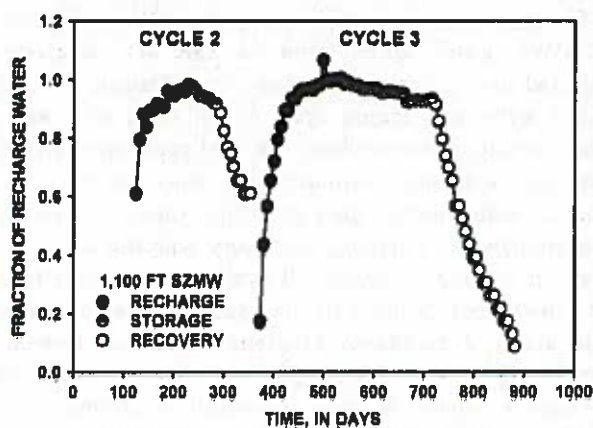


Figure 2. Conservative chloride mixing model for cycle tests 2 and 3 at the 1100 feet SZMW. Data are shown in Table S1.

The Kissimmee River ASR System and Cycle Testing History

The KRASR system is located on the eastern bank of the Kissimmee River near its confluence with Lake Okeechobee, Florida (Figure 1). The ASR system was designed for minimal pre-treatment of Kissimmee River source water prior to recharge into the UFA storage zone. Pre-treatment consists of pressurized media filtration and ultraviolet disinfection at a recharge rate of 5 million gal/d (MGD; 18.9 megaliters/d, MLD).

Groundwater is recovered at a rate of 5 MGD, with diversion of the first 0.3 million gallons (MG; 1.1 megaliters, ML) of turbid water to on-site storage ponds. When turbidity, pH, and specific conductance criteria are achieved, recovered water is re-oxygenated over a cascade aerator and returned to the Kissimmee River.

More detailed information about system design and operation are found at US Army Corps of Engineers (USACE 2004, 2012).

Each ASR cycle test consists of recharge, storage, and recovery phases. Three cycle tests were completed at KRASR between 2009 and 2011 (Table 1). Each successive cycle test increased in duration and volume stored. Recovery exceeded 100% of the recharged volume during cycle 1 so that aquifer arsenic concentrations were returned to initial values (below 10 µg/L) prior to cycle 2. Interpretations are based primarily on data acquired during cycles 2 and 3 because these cycles represent intended ASR system operations.

Data Collection Effort

A single ASR well is surrounded by four SZMWs (Figure 1), designated by their lateral distances from the

Table 1
Recharge, Storage, and Recovery Pumping Rate, Durations, and Volumes During KRASR Cycle Tests

Phase	Start Date	End Date	No. of Days	Avg. Pumping Rate, in MGD (MLD)	Volume, in MG (ML)		Percent Volume Recovered
					Recharge	Recovery	
Cycle 1							
Recharge	January 12, 2009	February 9, 2009	28	4.7 (17.8)	128.5 (486.4)	—	—
Storage	February 9, 2009	March 9, 2009	28	—	—	—	—
Recovery	March 9, 2009	April 17, 2009	39	4.8 (18.2)	—	183.8 (695.7)	143%
Cycle 2							
Recharge	May 11, 2009	August 28, 2009	109	3.8 (14.4)	334.23 (1.27)	—	—
Storage	August 28, 2009	October 28, 2009	61	—	—	—	—
Recovery	October 28, 2009	January 2, 2010	66	4.0 (15.1)	—	331.5 (1255)	99%
Cycle 3							
Recharge	January 19, 2010	July 9, 2010	171	4.9 (18.5)	793.1 (3002)	—	—
Storage	July 9, 2010	January 4, 2011	178	—	—	—	—
Recovery	January 4, 2011	June 17, 2011	164	4.98 (18.9)	—	805.5 (3049)	102%

ASR well: 350 feet (107 m), 1100 feet (335 m), 2350 feet (716 m), and 4200 feet (1,280 m). Each monitor well has an open interval identical to that of the ASR well, between -543 and -856 feet (-166 and -261 m) NGVD29. Two SZMWs located farthest from the ASR well were constructed during cycle 2, so data were obtained at these distal wells only during cycle 3. All wells were sampled weekly at the wellhead for field parameters, major and trace inorganic constituents, nutrients, and microbes for the entire testing duration, using standard methods for groundwater sampling, laboratory analyses, and quality control (FDEP 2008). All analyses were performed at laboratories certified by the National Environmental Laboratory Accreditation Program. In addition to wellhead samples, the 350 feet SZMW is instrumented with a SeaCat 19plusV2Profiler, (Sea-Bird Electronics Inc., Bellevue, Washington), which is suspended downhole in the UFA preferential flow zone at -588 feet (-186 m) NGVD29. The SeaCat 19plusV2Profiler provided hourly in-situ measurements of pH, temperature, specific conductance, dissolved oxygen (DO), oxidation-reduction potential (ORP), and pressure through each cycle test. Because DO is the primary electron acceptor during pyrite oxidation, in-situ DO measurements at a location 350 feet away from the ASR well are particularly important to quantify proximal redox conditions in the storage zone. The SeaCat Profiler measures DO using a Clark polarographic membrane with a gold cathode, which is more stable and is not affected by dissolved hydrogen sulfide compared to sensors with a silver cathode (Sea-Bird Electronics Inc. 2012). The SeaCat Profiler was installed on January 25, 2009 (cycle 1 recharge), and checked during monthly data downloads. The DO sensor began to fail sometime during August 2009, so Cycle 2 DO values are not presented. Power supply issues caused interruption to the continuous record from this probe between 30 March and 22 August 2010. The SeaCat Profiler was recalibrated at the manufacturer between 13 February and

30 March 2010 (cycle 2) and between 1 June and 9 July 2011 (cycle 3).

Source Water and Native Floridan Aquifer Water Quality

The Kissimmee River is the source of recharge water, and water-quality data reflect dry and wet season conditions through the cycle tests (Table 2). Recharge water quality is characterized using samples from the ASR wellhead during the recharge phase of all cycle tests. Recharge water is oxic, and has neutral pH, low carbonate alkalinity, low total dissolved solids (TDS) concentrations, and relatively high concentrations of total and dissolved organic carbon, iron, phosphorus, and color; and low to non-detectable concentrations of nitrate and manganese (Table 2).

The native UFA at this location is relatively fresh as indicated by low chloride and TDS concentrations and specific conductance values (Table 2). Native UFA groundwater at KRASR is characterized as sulfate-reducing and has slightly alkaline pH, moderate carbonate alkalinity and sulfate concentrations, and low concentrations of metals including iron. Arsenic concentrations generally are less than 3 µg/L.

Geochemical Calculations

Geochemical characterization was performed using public domain codes developed by the U.S. Geological Survey. The aquifer redox condition was evaluated using the Redox Processes Workbook by Jurgens et al. (2009). Mineral saturation indices and charge balance errors for each complete water quality analysis was performed using PHREEQC, version 2.17 with the Wateq4f database (Parkhurst and Appelo 1999), with data entry facilitated with the Excel interface NetpathXL (Parkhurst and Charlton 2008). The choice of controlling redox couple in PHREEQC will determine mineral stabilities. In each water sample, if DO concentration is greater than 0.05 mg/L (the field detection limit), the dissolved oxygen (O^{-2}/O^0) couple is used; if DO is below

Table 2
Recharge Water Quality and Native Floridan Aquifer Water Quality

Constituent or Parameter	Unit	Recharge Water Quality				Native UFA Water Quality at KRASR			
		Mean	Std Dev	Median	N	ASR WELL	1100 feet SZMW	2350 feet SZMW	4200 feet SZMW
Temperature	°C	25.3	6.0	28.3	46	25.5	25.2	24.3	24.9
Specific conductance	μS/cm	227	46	204	46	1347	1300	983	1404
pH	std. units	6.7	0.4	6.6	46	7.80	7.97	7.95	8.05
Oxidation–reduction potential	mV	130	59	114	46	–283	–179	–430	–249
Dissolved oxygen	mg/L	4.5	2.5	3.5	46	0.3	0.02	0.52	0.82
Color	PCU	91	32	90	44	5	10	—	—
Calcium	mg/L	19.2	4.9	17.0	44	51.5	47	28	27
Magnesium	mg/L	4.8	0.9	4.7	44	38.7	33	30	33
Sodium	mg/L	16.1	3.8	14.0	45	152	150	59	110
Potassium	mg/L	4.0	0.6	4.1	44	8.3	7.2	4.7	8.3
Sulfate	mg/L	15.6	6.5	14.0	45	198	150	170	200
Sulfide	mg/L	0.1	0.3	0.01	44	0.8	<1.0	1.1	1.2
Chloride	mg/L	31.1	7.5	28.0	45	242	260	140	160
Total alkalinity as CaCO ₃	mg/L	50	51	36	45	91	84	80	87
Dissolved organic carbon	mg/L	15.3	1.5	15.5	14	—	1.2	—	—
Total organic carbon	mg/L	16.3	1.0	17.0	13	<1.0	1.3	—	—
Arsenic	μg/L	0.9	0.5	0.8	45	<2.6	1.6	0.81	1.2
Iron	μg/L	226	68	230	45	28	65	23	<2.4
Manganese	μg/L	4.5	2.8	3.6	45	<3.8	4.3	1.1	0.57
Nitrate	mg/L	0.142	0.101	0.100	29	0.100	<0.025	<0.003	<0.003
Phosphorus	μg/L	64	32	54	43	0.010	<0.008	—	—

Note: Concentrations reported as "less than" are below the method detection limit. Recharge water data are measured at the ASR wellhead. Native UFA data are from single samples obtained prior to cycle testing. N is number of samples.

detection, the sulfur (S^{-2}/S^{+6}) couple is used for Eh calculations.

Results

Redox Environment of the Native Floridan Aquifer System

The sulfate-reducing redox environment is the native condition of the KRASR storage zone as interpreted from groundwater redox couple concentrations. Chapelle et al. (2009) proposed geochemical criteria to distinguish iron-reducing from sulfate-reducing conditions in groundwater using the Fe^{2+}/H_2S mass ratio, when dissolved oxygen, nitrate, and manganese are absent. The native redox environment in the UFA storage zone at KRASR is sulfate-reducing on the following bases: (1) that low to non-detectable concentrations of dissolved oxygen, nitrate, and manganese species do not contribute significantly to redox condition; and (2) that the Fe^{2+}/H_2S mass ratio in native UFA samples collected at the KRASR system is <0.3 (Table 3).

Redox Evolution During ASR Cycle Tests

Redox evolution in the UFA during cycle testing is defined in space and time. The spatial component is defined by reactions along the flowpath from the point of recharge (ASR well) to the 350 feet SZMW and the 1100

feet SZMW. No water-quality changes were detected at distal SZMWs (2350 and 4200 feet; Tables S3 and S4) during cycles 2 and 3, so data from these SZMWs serve as background (Table 3). The temporal component is defined through time-series presentation of groundwater data at a single monitor well through recharge, storage, and recovery phases during cycle tests 2 and 3. Interpretations will show redox evolution in both space and time.

Redox evolution in the UFA during cycle tests 2 and 3 is interpreted similarly to that of the native UFA, using (1) Fe^{2+}/H_2S mass ratios from ASR well and SZMW samples (Figure 3); and (2) wellhead and SeaCat Profiler measurements of DO and ORP at depth in the 350 feet SZMW (Figure 4).

The recharge phase of an ASR cycle test introduces DO, organic carbon, and ferric iron into the UFA, which shows low native concentrations of these solutes (Table 2). Source water (Kissimmee River, as measured during recharge at the ASR well) concentrations of redox-sensitive species vary seasonally: DO ranges from 1.6 to 8.8 mg/L; organic carbon ranges from 12 to 18 mg/L; and total iron ranges from 0.060 to 0.360 mg/L (Table 2; Tables S2 through S4). Ferric iron probably is complexed to organic carbon in source water rather than as a particulate phase, as recharge water is highly colored and shows total suspended solids concentrations typically less than the detection limit at 5.0 mg/L. ASR well clogging

Table 3
Characterization of Sulfate-Reducing Redox Environment in the Native UFA (mg/L)

Well	ORP	Nitrate	Manganese	Iron	Sulfate	Sulfide	Fe ²⁺ /H ₂ S	Arsenic	Location
Chapelle et al. (2009) criteria ¹	—	<0.5	<0.05	≥0.1	>0.50	—	<0.30	0.010 ²	—
ASR Well (May 5, 2004)	-283	0.10	<0.0038	0.028	200	0.8	0.035	<0.026	KRASR
2350 feet SZMW (January 6, 2010)	-430	<0.0030	0.0011	0.028	170	1.1	0.025	0.0008	KRASR
4200 feet SZMW (January 6, 2010)	-249	<0.0030	<0.001	0.024	200	1.2	0.020	0.0012	KRASR
OKF-101 (November 18, 2010) ³	-146	<0.015	0.0025	0.060	230	1.8	0.033	0.0047	5 mi. east of KRASR
HIF-42 (April 4, 2008) ³	—	0.11	0.0024	0.036	200	0.38	0.095	<0.005	5 mi. north of KRASR

¹Criterion for sulfate-reducing redox environment. All values are in mg/L.

²Arsenic criterion is the Maximum Contaminant Level from the Safe Drinking Water Act.

³Nearby background UFA monitor wells of the South Florida Water Management District.

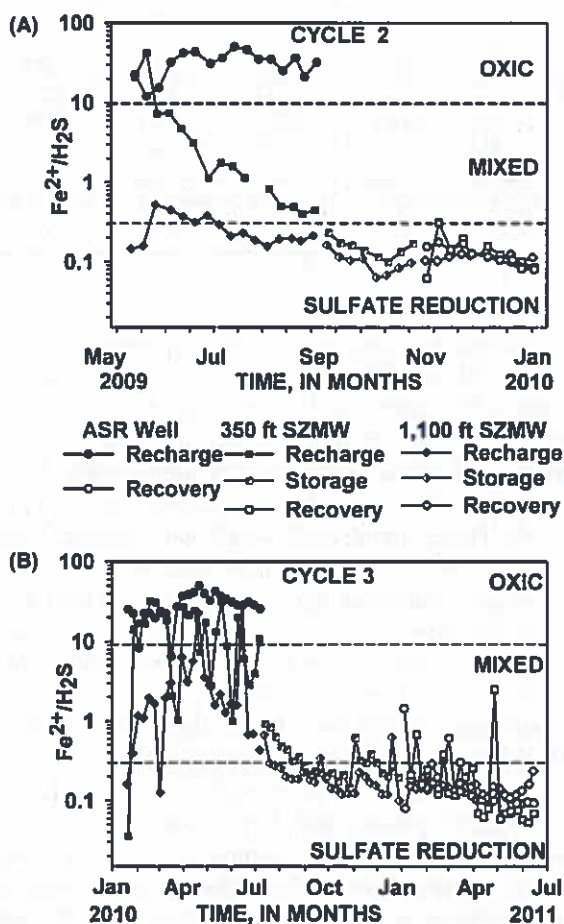


Figure 3. Redox evolution of the ASR storage zone (upper FAS) during cycle tests 2(A) and 3(B) as shown by Fe²⁺/H₂S values as indicators of redox environment. SZMW, storage zone monitor well. Data are shown in Tables S3 and S4.

from mineral precipitation was not observed during three cycle tests. Recharge water also dilutes and displaces native UFA sulfate concentrations (Table 2).

During cycles 2 and 3 recharge, SZMW samples show Fe²⁺/H₂S values greater than 0.3 (Figure 3A and 3B) indicating that the aquifer redox environment is sub-oxic, and is characterized by both ferric iron- and sulfate-reduction reactions. These reactions likely are coupled to oxidation of organic carbon by native and recharge water microbes (Vanderzalm et al. 2006). Native sulfate-reducing conditions in the storage zone are perturbed temporarily, resulting from iron, organic carbon, and DO transport through a sulfate-reducing UFA redox environment. Farther from the ASR well at both 350 and 1100 feet SZMWs, Fe²⁺/H₂S values decrease, indicating that mixed ferric iron- and sulfate-reduction redox couples dominate as DO is depleted along the flowpath.

SeaCat Profiler data and wellhead sample data from the 350 feet SZMW show redox evolution in the UFA at a proximal position away from the ASR well (Figure 4A and 4B). In particular, these data quantify DO transport and fate during recharge because the SeaCat Profiler is deployed directly in the upper preferential flow zone of the UFA at -588 feet NGVD29. Pyrite oxidation will continue as long, and as far away from the ASR well, as DO persists. As recharge water flows away from the ASR well, DO concentrations diminish from a range of 2 to 8 mg/L at the ASR wellhead, to 0.01 to 1.5 mg/L at the 350 feet SZMW, and <0.25 mg/L at the 1100 feet SZMW (Tables S3 and S4). DO and positive ORP values are detected in 350 feet SZMW wellhead samples approximately 2 weeks after the onset of recharge in cycles 1 and 3, resulting in an apparent horizontal flow velocity of 25 ft/d to the east. During later recharge, DO concentrations and ORP values in all SZMW wellhead samples decrease to <0.06 mg/L and <-100 mV respectively. Iron and organic carbon concentrations also decline along the flowpath during recharge (Tables S3 and S4).

SeaCat Profiler and wellhead sample data obtained during cycle 1 at the 350 feet SZMW show that

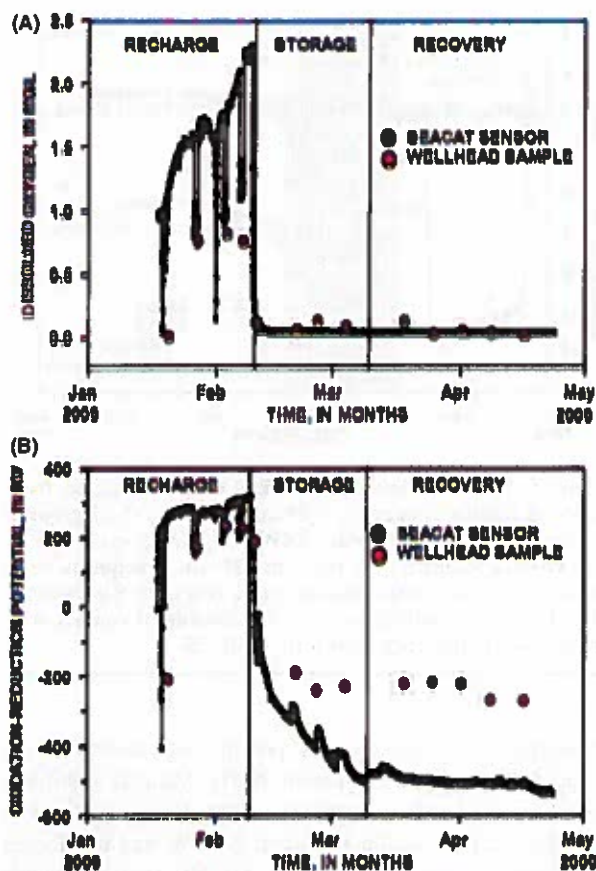


Figure 4. Dissolved oxygen (A) and ORP values (B) measured during cycle test 1 by the SeaCat Profiler suspended in the 350 feet SZMW at -588 feet (-186 m) NGVD29.

perturbation of the aquifer redox environment during recharge is temporary (Figure 4). During recharge, DO is detected in-situ at higher concentrations (~1.5 to 2.5 mg/L) compared to wellhead samples (0.01 to 1.5 mg/L). Upwelling of deeper, low DO water during well purging and sampling results in lower wellhead DO concentrations (Figure 4). Similarly, SeaCat Profiler ORP values also are slightly more positive than wellhead values. SeaCat Profiler data clearly show the rapid decay of DO at a single location once recharge ends. DO declines from an average concentration of 1.6 mg/L ($n = 384$ readings) during cycle 1 recharge, to below detection (0.05 mg/L) within 5 d. A conservative half-life ($t_{1/2}$) calculated for DO reduction is 25 h.

A few weeks after initiating cycles 2 and 3 recharge, redox conditions in the storage zone evolve from sub-oxic to mixed iron- and sulfate-reducing redox conditions (Figure 3). $\text{Fe}^{2+}/\text{H}_2\text{S}$ values continue to decline below 0.3 at all SZMWs during late recharge and storage of cycles 2 and 3. The native UFA is iron-poor in this area ($<24 \mu\text{g/L}$; see 2350 and 4200 feet SZMW "background" data in Table S4), so ferric iron reduction does not contribute significantly to native UFA redox equilibria. Introduction of iron-rich recharge water into the sulfate-reducing UFA allows a new redox couple to react in the storage zone.

During storage and recovery, DO is depleted, and the aquifer redox environment continues to evolve such that sulfate reduction becomes the dominant redox reaction. $\text{Fe}^{2+}/\text{H}_2\text{S}$ values decline below 0.3 in all SZMWs, and equilibrate during the first two months of cycles 2 and 3 storage (Figure 3). SeaCat Profiler ORP values are very negative (-400 to -500 mV; Figure 4), more so than wellhead samples (-280 to -300 mV). This disparity may result from a pressure effect on dissolved hydrogen gas equilibrium.

Arsenic Trends During ASR Cycle Tests

Arsenic concentration trends through three cycle tests show several common characteristics when data from all wellhead samples are compared (Figure 5). Maximum arsenic concentrations were measured during cycle 1 in all wells, when the initial exposure of the aquifer to DO occurred. Subsequent cycles show arsenic concentration maxima occurring in SZMW wellhead samples during recharge or early storage, then declining through late storage and recovery. This pattern reflects reactive transport (during recharge) and reactions (during storage) of iron and arsenic as the aquifer redox environment evolves from a sub-oxic to sulfate-reducing condition. Arsenic concentration maxima, and concentrations that exceed the 10 $\mu\text{g/L}$ regulatory criterion, coincide with mixed ferric iron- and sulfate-reduction redox environment in the UFA (Figure 5 and Tables S3 and S4). The duration that arsenic exceeds the MCL in the aquifer is approximately 150 d (cycle 2: 3-month recharge, 241-d cycle), and 290 d (cycle 3: 6-month recharge, 513-d cycle), and these exceedances only occur during recharge and early storage phases.

Arsenic concentration trends observed during the static conditions of storage result primarily from geochemical reactions, rather than reactive transport. Declining arsenic concentrations measured at the 350 and 1100 feet SZMWs during cycle 3 storage (Figure 5) suggest that in-situ geochemical reactions are sequestering arsenic in a solid phase, coincident with sulfate-reducing conditions. During cycle tests 2 and 3 storage, arsenic concentrations declined below the 10 $\mu\text{g/L}$ regulatory criterion, prior to the onset of the recovery phase. Consequently, with the exception of one sample in cycle 3 (Figure 5A), all recovered water is in compliance with the Safe Drinking Water Act arsenic criterion. Arsenic exceedances are temporary in the UFA, occurring only during late recharge and storage.

The chloride-based conservative mixing model (Figure 2) supports the geochemical sequestration interpretation. There is little to no change in the fraction of recharge water ($>90\%$) at the 1100 feet SZMW through cycle test 2 and 3 storage, concurrent with declining arsenic concentration. Under static (non-pumping) conditions of storage, groundwater flow in the UFA does not cause significant mixing of native and recharge water over the durations of cycle tests 2 and 3 (at least in proximal positions in the wellfield), so that concentration trends are not affected by advective transport.

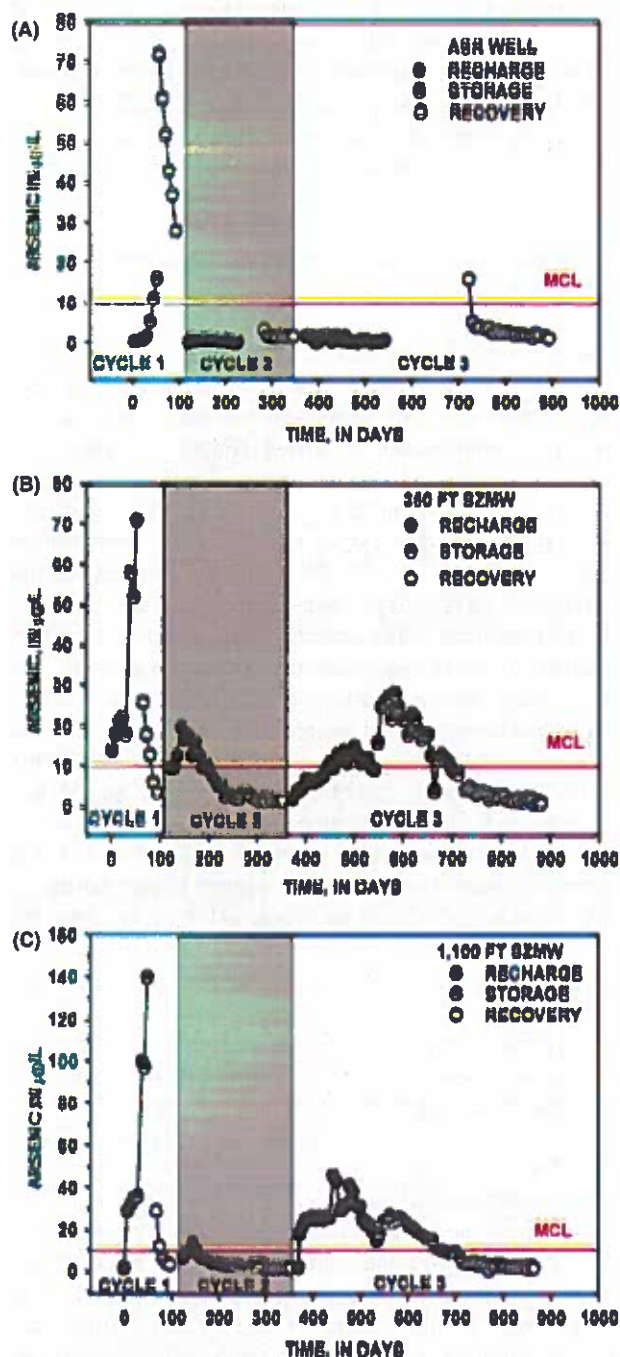


Figure 5. Arsenic concentrations measured in wellhead samples during cycle tests 1 through 3 at the ASR well (A), the 350 feet SZMW (B), and the 1100 feet SZMW (C).

Discussion

Iron Mineral Stabilities During ASR Cycle Tests

Mineral saturation indices (SI) were calculated for each wellhead sample collected during cycle tests 2 and 3. Because both cycle tests show identical trends, only SI values from cycle 3 are presented (Figure 6). Two mineral phases are considered: amorphous iron oxyhydroxide ($\text{Fe}(\text{OH})_3(\text{a})$), which is stable under oxic and sub-oxic conditions; and amorphous iron sulfide (FeS), which is

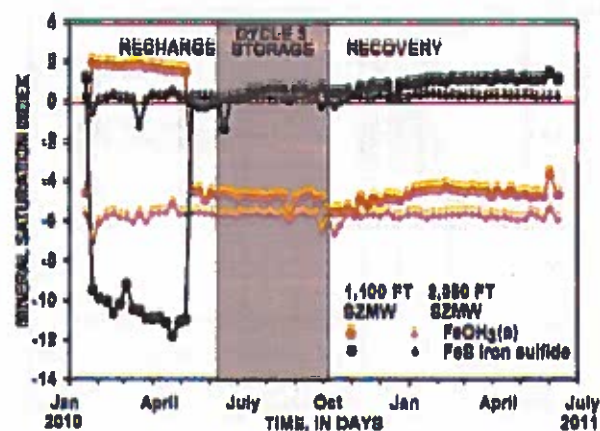


Figure 6. Mineral saturation indices (SIs) calculated from wellhead sample data at the 1100 and 2350 feet (background) storage zone monitor wells (SZMWs) during cycle test 3. Positive SIs indicate that the mineral will precipitate or is stable in contact with groundwater. Negative SIs indicate that the mineral will dissolve or is unstable in contact with groundwater. Data are shown in Table S5.

the initial iron sulfide phase to precipitation under sulfate-reducing conditions (Schoonen 2004). Mineral stabilities are interpreted at two locations in the storage zone away from the ASR well: the 1100 feet SZMW that is affected by recharge, and the 2350 feet SZMW that represents native UFA conditions. Saturation indices do not change throughout the cycle at the 2350 feet SZMW, confirming that recharge water has not been transported to this distal location in the UFA. Calculated SI values are tabulated in Table S5 for all samples.

The recharge portion of a cycle test shows the greatest change in native mineral stabilities (Figure 6). In the presence of DO in the storage zone, amorphous iron oxyhydroxide is stable as a solid as shown by positive SI values. Iron sulfide is not stable, as shown by negative SI values. During late storage and recovery, the UFA redox environment shifts from sub-oxic, to mixed iron- and sulfate-reduction, and ultimately pure sulfate-reducing conditions. Amorphous iron oxyhydroxide is lost through reductive dissolution under sulfate-reducing conditions. Negative SI for values for iron oxyhydroxide appear late in recharge and continue through the end of the cycle. Simultaneously, amorphous iron sulfide SI values become positive, indicating stability through the end of the cycle, as native sulfate-reducing redox conditions are re-established.

Arsenic Sequestration During KRASR Cycle Tests

Iron mineral stabilities control the appearance, transport, and fate of arsenic in an aquifer. The testable hypothesis for arsenic sequestration during KRASR cycle tests is: if geochemical concentrations and redox conditions that favor precipitation of a stable iron sulfide phase are established during storage and recovery, then dissolved arsenic will be sequestered in the iron sulfide phase. Arsenic sequestration in iron sulfide phase is preferable to that of iron oxyhydroxide, because the

former more closely represents native UFA mineralogy in which arsenic occurs at concentrations generally $<3 \mu\text{g/L}$.

During recharge, iron-rich recharge water plus iron released during pyrite oxidation can precipitate as amorphous iron oxyhydroxide ($\text{Fe}(\text{OH})_3(\text{a})$). Iron oxyhydroxide is stable under oxic to sub-oxic redox conditions that characterize the storage zone during early recharge. Dissolved arsenic is released during pyrite oxidation, and subsequently can be sequestered by co-precipitation, sorption, or complexation to the iron oxyhydroxide surface (Waychunas et al. 1993; Dixit and Hering 2003). Unfortunately, arsenic sequestration by iron oxyhydroxide surfaces is only temporary, occurring during the oxic redox conditions of recharge of each cycle test.

During late recharge and early storage, the storage zone evolves to sub-oxic and mixed ferric iron- and sulfate-reducing conditions. Iron oxyhydroxide undergoes reductive dissolution by dissolved sulfide, and sorbed arsenic is released again into groundwater (O'Day et al. 2004; Poulton et al. 2004; Onstott et al. 2011). Ferrous iron (Fe^{2+}) is released into groundwater where it is transported during late recharge along with arsenic. Thus, in sub-oxic aquifer redox environments, or in the presence of nitrate (a competing electron acceptor with ferric iron), arsenic will remain in solution. A sequence of arsenic sequestration and release under sub-oxic redox conditions (in the presence of nitrate) was demonstrated during cycle tests at the Bolivar reclaimed water ASR system (Vanderzalm et al. 2011).

During storage, sulfate-reducing conditions are re-established in the UFA storage zone, which favors the stability of iron sulfide minerals. Sufficient dissolved iron, sulfide, and the absence of nitrate and manganese are required for iron sulfide precipitation to proceed (Wilkin and Barnes 1997; Butler and Rickard 2000). Concomitant co-precipitation of arsenic in the new iron sulfide phase has been documented in other aquifers (Rittle et al. 1995; Kirk et al. 2004; Root et al. 2009), but has not been documented at any other ASR system to date.

At KRASR, arsenic sequestration is demonstrated by the synchronous evolution of sulfate-reducing redox conditions in the storage zone, accompanied by decreasing arsenic concentrations in all SZMWs during storage and recovery of cycle tests 2 and 3. As each cycle test proceeds from recharge to recovery, arsenic concentrations and $\text{Fe}^{2+}/\text{H}_2\text{S}$ mass ratios decline. The simultaneous decline in these geochemical characteristics in all SZMW samples supports the arsenic sequestration hypothesis at KRASR wellfield.

Conclusions

Arsenic mobilization at Florida ASR systems has slowed implementation of subsurface storage because water managers are hesitant to invest in facilities that may not operate in regulatory compliance. Extensive water-quality monitoring at the Kissimmee River ASR system during three cycle tests shows that arsenic mobilization is a temporary process. Arsenic is transported

primarily when the aquifer redox environment is characterized by sub-oxic or mixed iron- and sulfate-reducing conditions during recharge, concomitant with $\text{Fe}^{2+}/\text{H}_2\text{S}$ values >0.3 . Arsenic concentrations can exceed the Safe Drinking Water Act regulatory standard ($10 \mu\text{g/L}$) under these aquifer redox conditions. As a cycle test proceeds through storage and recovery phases, the redox environment of the UFA is re-established as the native, sulfate-reducing condition ($\text{Fe}^{2+}/\text{H}_2\text{S} < 0.3$) that favors arsenic sequestration in iron sulfide solids. Amorphous iron sulfide mineral stability is indicated by positive mineral saturation indices in SZMWs during storage and recovery. Co-precipitation of arsenic with iron sulfide in recovered water during cycles 2 and 3 results in arsenic concentrations that are in compliance with the Safe Drinking Water Act regulatory standard ($<10 \mu\text{g/L}$).

The mechanism for arsenic sequestration defined here is appropriate for ASR systems having the following characteristics: (1) recharge water that has sufficient iron and organic carbon to stimulate aquifer microbes; (2) recharge water that has negligible concentrations of other electron acceptors (manganese and nitrate) that inhibit sulfate reduction; and (3) a native sulfate-reducing aquifer redox environment.

Acknowledgments

The authors thank the following for years of support and dedication to the project. R2T, Inc. (Atlanta, Georgia) as operators of the KRASR system; B. Clark and W. Leonard (Amec, Inc.) who served as the field sampling and data QA team; B. Verrastro and R. Nevulis (South Florida Water Management District) for hydrogeologic expertise; and P. Petrey (Applied Drilling) for insight into sensor deployment and operation. The authors also thank P. Hansard and C. Fischler (Florida Geological Survey) for reviewing an earlier version of this manuscript. The comments of T. Missimer and two anonymous reviewers greatly improved the quality of the draft.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Table S1. Mixing Model

Table S2. Cycle Test 1

Table S3. Cycle Test 2

Table S4. Cycle Test 3

Table S5. Mineral Saturation Indices Cycle Test 3

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Proposed Draft Agenda for ASR Meeting with FDEP
Fred McManus to: donnie.mcclaugherty

11/07/2012 10:47 AM

Here you go Donnie.

Fred



Draft Agenda - VTC with FDEP on ASR November 19 2012 11 07 12.docx

EPA Region 4 and HQ Video Teleconference with FDEP

Aquifer Storage and Recovery in Florida

November 19, 2012 – 1:00-4:00

Draft Agenda

1. Welcome – Jim Giattina/Ann Codrington (10 min)
2. Introductions – All (5 min)
3. Confirm the Issue/Problem – Mark Thomasson (20 min)
4. Review and Discuss ASR Implementation Options that FDEP has Proposed – Mark Thomasson/All (45 min)
5. Review and Discuss Approaches for Future Consideration – Jim Giattina/Ann Codrington/All (60 min)
6. Action Items and Next Steps – Jim Giattina/Ann Codrington/Mark Thomasson/All (30 min)
7. Closing Remarks – Jim Giattina/Ann Codrington/Mark Thomasson (10 min)
8. Adjourn



RE: ASR - Reactive Transport Model & Bradenton Degas Pilot Test Results

McClaugherty, Donnie

to:

Fred McManus

07/16/2012 04:23 PM

Hide Details

From: "McClaugherty, Donnie" <Donnie.McClaugherty@dep.state.fl.us>

To: Fred McManus/R4/USEPA/US@EPA

1 Attachment



image001.gif

Elsa and Joe would like to listen in. We are not available on Wednesday from 2:00 to 3:00 and Thursday.
Thanks, Donnie

Please take a few minutes to share your comments on the service you received from the department by clicking on this link. [DEP Customer Survey](#).

From: Fred McManus [<mailto:Mcmanus.Fred@epamail.epa.gov>]

Sent: Monday, July 16, 2012 10:07 AM

To: Becky Allenbach

Cc: Stuart Norton; Dr. Mike Annable; McClaugherty, Donnie; Lee Thomas; Nancy Marsh; James Ferreira

Subject: Re: ASR - Reactive Transport Model & Bradenton Degas Pilot Test Results

Hello All:

Let me know about your availability for a conference call on the following dates/times. Based on responses, I will schedule the call and send an invite with call-in number and conference code. Also, Dr. Norton, please email your presentation to those listed above.

Tuesday, 7/24 - 1:00-2:00
3:00-4:00

Wednesday, 7/25 - 9:00-10:00

10:00-11:00
2:00-3:00
3:00-4:00

Thursday, 7/26 - 9:00-10:00
10:00-11:00
3:00-4:00

Thanks,

Fred

▼ Becky Allenbach---07/13/2012 04:17:47 PM---Can we make this happen the week of July 23rd? Becky B. Allenbach, Chief

From: Becky Allenbach/R4/USEPA/US
To: Stuart Norton <stuartnorton@me.com>
Cc: "Dr. Mike Annable" <annable@ufl.edu>, Donnie.McClougherty@dep.state.fl.us, Fred McManus/R4/USEPA/US@EPA
Date: 07/13/2012 04:17 PM
Subject: Re: ASR - Reactive Transport Model & Bradenton Degas Pilot Test Results

Can we make this happen the week of July 23rd?

Becky B. Allenbach, Chief
Safe Drinking Water Branch
EPA Region 4 - Water Protection Division
(404)562-9687
Allenbach.Becky@epa.gov

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▼ Stuart Norton ---05/31/2012 08:13:05 AM---Becky, Yes, a teleconference might work best for all. I agree that it's a good idea to invite the f

From: Stuart Norton <stuartnorton@me.com>
To: Becky Allenbach/R4/USEPA/US@EPA
Cc: Fred McManus/R4/USEPA/US@EPA, Donnie.McClougherty@dep.state.fl.us, "Dr. Mike Annable" <annable@ufl.edu>
Date: 05/31/2012 08:13 AM
Subject: Re: ASR - Reactive Transport Model & Bradenton Degas Pilot Test Results

Becky,

Yes, a teleconference might work best for all. I agree that it's a good idea to invite the folks from FDEP. While the FDEP-UIC folks are familiar with the Bradenton project, I'll be presenting some new material.

Looking at my calendar - I could present the last week of June. I'd then have to skip forward a couple of weeks, due to project work, to the third or fourth week of July.

Have a great day,

Stuart B. Norton, Ph.D.

UF - Environmental Engineering

Office: (352) 505-1555

Cell: (352) 222-2005

Email: stuartnorton@me.com

On May 29, 2012, at 11:50 AM, Becky Allenbach <Allenbach.Becky@epamail.epa.gov> wrote:

Hi, Stuart:

We would be interested in hearing about your work. Did you have a teleconference in mind? Has FL DEP seen the presentation? Perhaps they could participate as well?

Becky

Becky B. Allenbach, Chief
Safe Drinking Water Branch
EPA Region 4 - Water Protection Division
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Stuart Norton ==05/25/2012 10:43:49 AM==Good morning Becky, I'd like to chat with you and some of your colleagues regarding our research of

From: Stuart Norton <stuartnorton@me.com>

To: Becky Allenbach/R4/USEPA/US@EPA

Date: 05/25/2012 10:43 AM

Subject: ASR - Reactive Transport Model & Bradenton Degas Pilot Test Results

Good morning Becky,

I'd like to chat with you and some of your colleagues regarding our research of ASR. As part of my Ph.D. research I worked with a team of scientist to develop a reactive transport model of the Bradenton Potable ASR facility. Comparative simulations were run to test techniques for controlling arsenic mobilization during ASR, including varying pretreatment levels of DO removal and process techniques (i.e., Target Storage Volume technique).

Would your group be interested in a 25-minute presentation covering this topic and the Bradenton Degasification Pilot project test results? It'd be great to get your feedback as we're looking for some direction to improve our work.

Thanks for your time and have a great holiday,
Stuart B. Norton, Ph.D.

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Slide show and agenda

McClaugherty, Donnie

to:

Fred McManus

08/29/2012 03:20 PM

Cc:

"Haberfeld, Joe"

Hide Details

From: "McClaugherty, Donnie" <Donnie.McClaugherty@dep.state.fl.us>

To: Fred McManus/R4/USEPA/US@EPA

Cc: "Haberfeld, Joe" <Joe.Haberfeld@dep.state.fl.us>

History: This message has been replied to and forwarded.

2 Attachments



Meeting with EPAagenda.docx ASR6overviewcomboepameet83012 dm_jgl 8 27 12.pptx

Hi Fred – attached is the agenda and slide show for tomorrow's meeting.

Thanks for everything.

Donnie

Please take a few minutes to share your comments on the service you received from the department by clicking on this link [DEP Customer Survey](#).

